

# Aviation Week & Space Technology

January 21, 1963

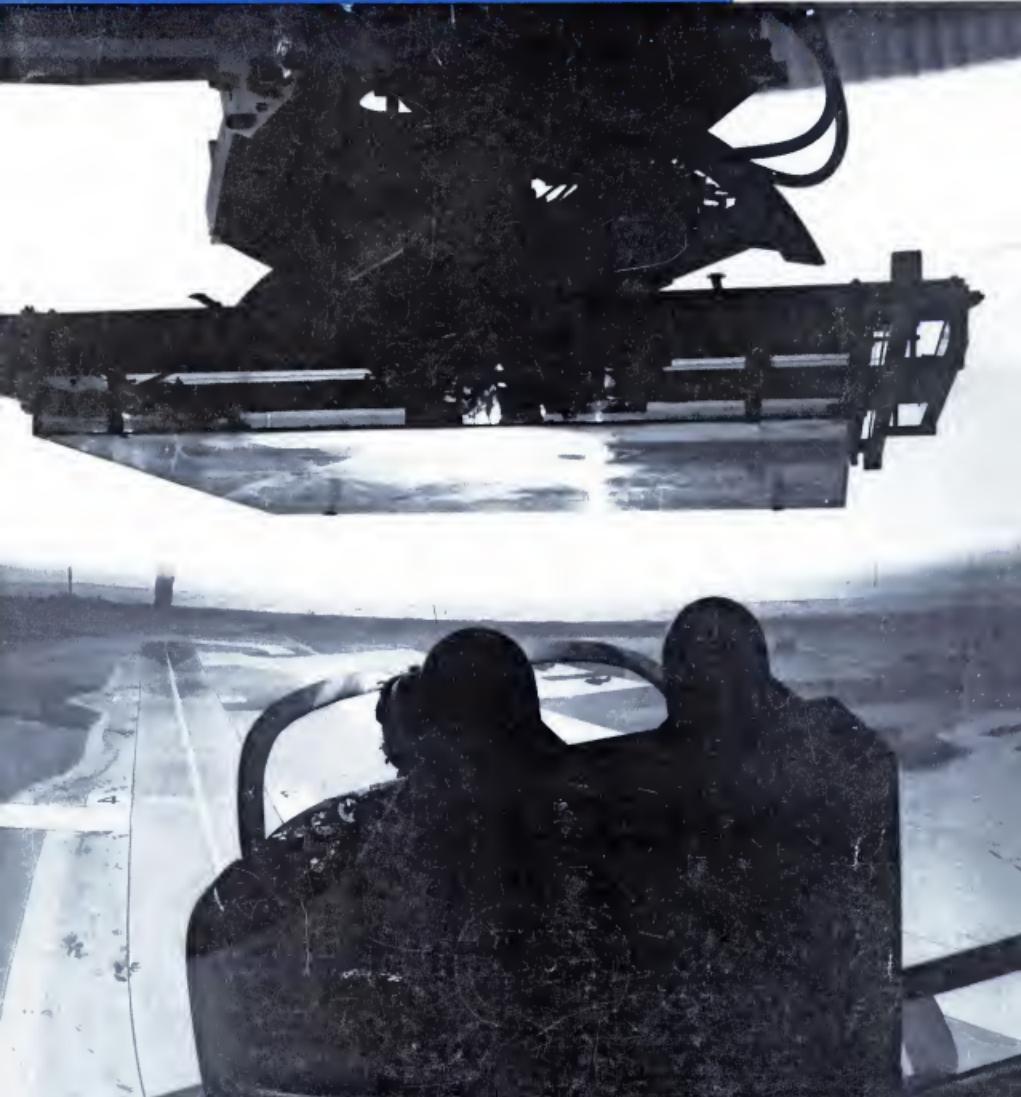
## SPECIAL REPORTS:

- MA-9 Tests
- XV-5A Details

Ryan Flight Simulator

75 Cents

A McGraw-Hill Publication



# M-1



Under development at Aerojet...

## AMERICA'S MOST POWERFUL LIQUID-HYDROGEN-FUELED ROCKET ENGINE

The Nation's largest and most sophisticated liquid oxygen/liquid hydrogen engine is now under development at Aerojet General's Liquid Rocket Plant. The engine, the M-1 space booster, which will deliver well in excess of 1,000,000 pounds of thrust to permit the launching of extremely heavy payloads. As an integral part of the M-1 project, Aerojet General® also is completing one of the largest test facilities in the world, including two 370,000 gallon liquid hydrogen storage tanks and test stands capable of handling boosters up to 3,000,000 pounds thrust.

The M-1 is being developed by the Liquid Rocket Plant for the National Aeronautics and Space Administration.



LIQUID ROCKET PLANT / Sacramento, California

## Blind Bolts

become part  
of simplified  
wing rework  
saving  
**\$2.8 million!**



Blind Bolts being installed in Boeing 747 upper forward skin covering panel because skin after wing rework had to be removed. Hi-Shear Corp. portable power tools (Hi-SHEAR) electronically operated model shearers® provide hydraulic power to the Blind Bolt gun. Air operated model is non-sparking and safe for use over flamed aircraft or launch-ready vehicles.

### INSTALLATION TOOLING



STANDARD  
DRIVING TOOLS  
are used in normally  
driven applications. Wrench  
shears automatically  
cut and strip blind bolts.



LEVERAGE  
DRIVING TOOLS  
are used in applications  
where standard tools  
are not available  
or where blind  
bolts are used.



OSCILLATE  
DRIVING TOOLS  
are used in applications  
where blind bolts  
are driven into  
thin sheet metal  
or where blind  
bolts are used.



BLIND  
BOLTS  
are located directly  
up through the skin  
and the skin has to be  
flamed back to  
make the blind  
bolts accessible  
to the blind  
bolt gun.

### WRITE FOR 24 PAGE NEW CATALOG

Hi-Shear  
CORPORATION

2800 WEST ANTHONY AVENUE / POMONA, CALIFORNIA  
U.S. PATENT & TRADEMARK REG. NO. 2,646,280. U.S. PATENT & TRADEMARK EXAMINER AND PUBLISHER





INSTANT  
INTELLIGENCE  
FOR INSTANT  
DECISIONS

Fairchild's new **Ground Sensor Terminal** provides real-time battlefield surveillance from a remote command post, that is what it does. The mobile Ground Sensor Terminal requires no photographic, infrared or radar views transmitted by an airborne reconnaissance system. The signals are displayed on a TV screen for instant evaluation. In the Ground Sensor Terminal, the signals are recorded on film and rapid-processed for high-resolution assessment. Position of the aircraft or ground is automatically plotted in precise geographic location on an area view.



## A COMPLETE VISUAL IMAGING SYSTEMS CAPABILITY



**DEFENSE PRODUCTS DIVISION**

## AEROSPACE CALENDAR

(Continued from page 1)

Feb 13-15-Space Vehicle Thermal and Atmosphere Control Systems, conducted by the Atmospheric Systems Division, McDonnell Douglas Corp., Dayton, Ohio. Sponsored by NASA Langley Research Center.

Feb 14-16-International Astronautics and Space Fair, Congress and Exposition, Thompson Park, San Antonio, Tex. Sponsored by Space Systems Division Foundation.

Feb 14-16-2nd International Conference on Crystal Growth, Highfield, Hampshire, U.K. Sponsored by Institute of Electrical and Electronics Engineers, University of Finsbury, U.K.

Feb 14-22-Western Region Conference on Space and Rocketry, Los Angeles, Calif. Sponsored by Los Angeles Section.

Feb 26-Mar 1-19th Annual Technical Conference, Society of Photo-Optical, Marks Hotel, Hollywood, Los Angeles, Calif. Sponsored by Society of Photo-Optical Engineers.

Mar 1-7-17th Annual Technical Conference, Optical Society of America, Hotel Statler, New York City, N.Y. Sponsored by Optical Society of America.

Mar 1-7-18th Annual Technical Conference, Marks Hotel, Hollywood, Los Angeles, Calif. Sponsored by Optical Society of America.

Mar 1-8-The 2nd Symposium, Hollywood Telecommunications, Calif. Sponsored by Hollywood Calif. State Bar.

Mar 1-9-Practical Meeting, Institute of the Aerospace Sciences, Cleveland, Ohio.

Mar 11-13-Electric Propulsion Conference, American Rocket Society, Bendix General, Cleveland, Ohio.

Mar 11-13-19th Annual Meeting, Optical Society of America, Hotel Statler, Los Angeles, Calif.

Mar 18-20-Space Flight Testing Conference, American Rocket Society and Jet Propulsion Laboratory, Pasadena, Calif.

Mar 18-22-1964 Western Metal Exposition and Congress, Pan Pacific Auditorium and Auditorium Hotel, Los Angeles, Calif.

Mar 19-24-Sixth Annual Air Force-sponsored Symposium on Space Sciences, Biltmore Hotel, Duran, Calif.

Mar 21-22-International Convention, Institute of Electrical and Electronics Engineers, Hotel Statler, Atlanta, Ga. and California, San Francisco, Calif.

Apr 5-11-4th Annual Structural and Materials Conference, American Rocket Society and Institute of the Aerospace Sciences, Hotel Statler, New York, N.Y.

Apr 2-3-Engineering Conference, Aeronautical Research Institute, Shawnee State, Ohio.

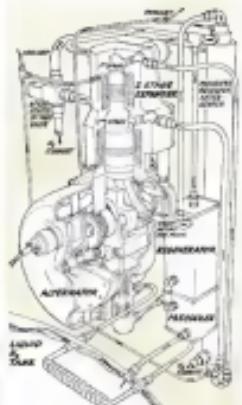
Apr 10-11-1964 Symposium on Propagation Aspects of Magnetohydrodynamics, University of California, Berkeley, Calif.

Apr 19-25-International Satellite Meeting (INTERMIS) Conference, Institute of Electrical and Electronics Engineers, Hotel Statler, New York, N.Y.

Apr 27-29-1964 International Conference on Electron Beam Irradiation of Polymers and Electron Beam Induced Polymerization, Delft University of Technology, Delft, Delft, The Netherlands.

Apr 17-20-Terrestrial Measuring Nuclear Methods for Radio Isotopes, American Institute of Physics, New York, N.Y.

## A RELIABLE SPACE POWER AND THERMAL CONTROL SYSTEM FOR LUNAR EXPLORATION



THE CRYOCYCLE-R is one space power system now in the advanced test phase at Sandiafiedz Andover, Denver. This system is unique in that it eliminates the problems of radiator development, orientation and protection, and the high weight of water evaporative cooling systems. Normally wasted energy (even the metabolic heat of the astronauts) is recovered and used. The working fluid, hydrogen, is heated both between stages and in the cylinders, significantly reducing the specific propellant consumption and providing simultaneous power generation and thermal control. Because it provides both

power and cooling, independent of the vehicle's external environment, the CRYOCYCLES-R permits the development of a single lunar vehicle for exploration of any part of the moon, and at any time of the lunar day or night. ■ Because it operates on cryogenic propellants (and can utilize "ballast") it also has many advantages for parking and rendezvous applications. ■ For an overall picture of Sundstrand's broad experience in chemical and solar dynamic space power systems, send a request to our Applications Engineering Department on your business stationery. ■ If you would like to work on the Sundstrand engineering team finding practical solutions to challenging space problems, write to Personnel Director.



SUNDSTRAND AVIATION: DIVISION

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A new corral for transient business flyers... But where the winged west begins?

Now at Fort Worth Meacham Field — that famous brand of Southwest Airline Service! We call it "The Business Flyers' Home on the Range — Cut Where the Winged West Begins!" Formerly Aircraft Sales, Inc., the same friendly folks are still around to give you better service. Southwest Airline — Fort Worth offers complete refueling facilities including all gasoline, octane, oil, and jet fuel, plus a radio dispatched fleet of modern trucks. Complete airplane, engine and prop maintenance, parts and supplies, charter service. Right training, airplane sales, even a radio-dispatched courtesy car! Famous Western Style Southwest Airlines series now available at Fort Worth Meacham Field, one of America's finest and best equipped general aviation airports.

Southwest Airmotive Company



## AEROSPACE CALENDAR

(Continued from page 7)

Mar. 18-19-National Society of Broadcast Engineers Annual Convention, Hotel Cincinnati, Ohio

Apr. 21-23—Annual Meeting, National Association of Broadcasters, Washington, D. C.

Apr. 23-24—National Massed Space Flight Symposium, Institute of the Aerospace Sciences in cooperation with NASA and AT&T, Dallas, Texas

Apr. 27-29—National San Diego Seminar for Broadcast Engineers, Del Mar Hotel, Coronado, San Diego, Calif.

Apr. 29-31—Highways, Railroads, Canals and Seacoast Roads and Harbor Survey Seminar, Rockwell Science Center, Soka University of Southern California, National Defense Laboratory, Whittier, Calif.

May 2-4-1965 Spring Meeting, Western States Section (The Committees Initially Varying from Year to Year), San Jose, Calif., California State University, San Jose, Calif.

May 20-22—Annual Meeting, American Institute of Electrical Engineers, Atlanta, Ga.

May 29-May 31—2nd Annual National Gas Research Society of Aeronautical Research Engineers Shortcourse, Hyatt Hotel, St. Louis, Mo.

May 30-May 31—Infrared Conference, Society of Photo-Optical Instrument Engineers, Ambassador Hotel, Atlanta, Ga.  $\times$   $\times$

June 13-19—Annual National Forum, American Hospital Association, Sheraton Hotel, Washington, D. C.

July 3—Infrareds Conference, American Radiant Society and American Metal of Los Angeles, Calif.

July 23—Fourth National Symposium on Design Factors in Electronics, Institute of Electrical and Electronics Engineers, Washington, D. C., Washington Hotel, Washington, D. C.

Aug. 14-17—Annual Conference, American Society of Naval Engineers, East Ocean City, Md., Hotel Chesapeake and Castle Rock Inn.

Sept. 8-10—Electro-Optics and Mass Spectrometry Meeting, Institute of the Aerospace Sciences, Washington, D. C.

Sept. 19—Electro-Optics Components Conference, Institute of Electrical and Electronics Engineers, Institute of the Aerospace Sciences, Washington, D. C.

Sept. 15-17—Concurrent General Flight Forum's Second National Symposium on Air Transportation, Hyatt Hotel, Calif.

Sept. 26-27—National Symposium on Micro and Miniature Techniques, Institute of Electrical and Electronics Engineers, Institute of the Aerospace Sciences, Vienna Hotel, Santa Monica, Calif.

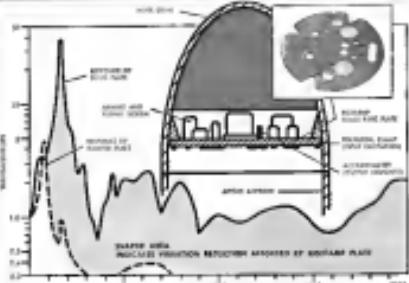
Sept. 29-31—National Telecommunications Conference, Hilton Hotel, Albuquerque, N. M.

Sept. 24-25—Spring Test Computer Conference, American Federation of Lubricating Engineers, Research Bureau, Cobo Hall, Detroit, Mich.

Sept. 25-27—Second National Conference on Product Engineering & Production, Institute of Electrical and Electronics Engineers, Conference Hotel, Cambridge, Mass.

June 19-20—25th Annual Forum International Air Show, Los Angeles, Calif.

## BARRY DAMPING IN ACTION



**Adding stiffness** (and that usually means mass) is a **suboptimal answer** to the problem of structural response to shock and vibration. Adding damping is a much more practical solution.

New Berry Controls offers two types of damping...the integral RIGIDAMP® technology, and a

**RIGIDMAMP** structures, with passive damping have proven time and again that you can have light-weight structures and controlled damping.

For example, the curve above compares the transmissibility of

an unchanged mounting plate for an existing and fixing system in the RIGIDAMF replacement. The shaded area represents reliability for critical plate mounted components.



Journal of Oral Rehabilitation 2003 30: 1033–1040



## Revised: 10/1/2010, 10:00 AM

SHOCK, VIBRATION AND NOISE CONTROL

**BARRY B CONTROLS**



## At -100°F all rubbers are disappointing

At -100°F below zero, other synthetic elastomers can hardly be tested, yet General Electric's silicone rubber is still flexible. At -100°F, silicone rubber can offer elongation of 500%, tear resistance of 300 psi, and tensile strength of 3,000 psi (even better than at room temperature). As a matter of fact, U.S. silicone rubber is commonly useful at -130°F, and intermittently to -220°F.



Rubber cones coated with G.E. silicone rubber remain flexible at temperatures extending and probably long beyond the melting point of most other rubbers. Even after such periods of exposure, the physical properties of G.E. silicone rubber and other properties show relatively little change from normal values.



Testing's modulus in flexure test shows the remarkable behavior of silicone rubber. Even after such periods of exposure, the physical properties of G.E. silicone rubber and other properties show relatively little change from normal values.



Silicone rubber pad for liquid oxygen canister insulation insulation is a valuable insulating equipment. A series of recessions help prevent the formation of pinholes, providing a remarkable combination of insulation effectiveness at temperatures from -65° to 300°F.

GENERAL  ELECTRIC

For further information on the low and high temperature properties of General Electric silicone rubber, write: General Electric, silicone rubber, Box 1600, General Electric Company, Schenectady, New York.



## except silicone rubber



# Babcock command-control systems go digital

Babcock, a leader in analog-type command guidance and stabilization systems, is now developing digital equipment that meets both the economic limitations and the more stringent reliability and accuracy demands of combat surveillance and missile target vehicle programs. By taking advantage of decreased bandwidth requirements and using time sharing techniques, Babcock makes it possible to control several vehicles simultaneously from a single ground station installation without mutual interference. This development is another example of Babcock's basic ability to convert advanced techniques into low cost, operable hardware.



AEROSPACE  
DIVISION **BABCOCK**

BABCOCK ELECTRONICS CORP.  
1640 Monrovia Avenue, Costa Mesa, California

## THE ABC'S OF PCM

If you have been paying proper attention to our always-factual propaganda, you of course know that Telemetrics' Universal PCM Decom Systems have been field-proven for 30<sup>2</sup> hours at more than 40 major NASA, military and industrial installations.

But it should come as a pleasant surprise to learn that the modular building-blocks of these almost-instable systems are now available individually.



Take, for instance, our Model 302 Digital Signal Simulator, which generates a completely programmable coded output to meet practically all lab and field requirements. You can use it to check out and calibrate computers, digital communications systems, digital voice transmission processors, data systems and PCM telemetry equipment.

Then there's our Model 6103 8-Digital Signal Synthesizer, to help capture wide frequency ranges of input PCM data from poor quality magnetic tapes and increase digital randomness signal to noise ratios, base line variations and rate variations. The 6103-8 option enables 16-bit digital signals, converts them into E2 or MR2 form, and provides a clock signal in frequency and phase sync with the input data.

Another good example is our Model #212 DAC Assembly. This device is plug-in modular assembly converts digital-coded information from programmed memory locations, with 120 oscillator-type outputs to drive high frequency galvanometers directly.

You'll find some little-known but very intriguing facts about all three of these components below. For the complete story, just ask for Data File 31A.

TELEMETRIES INC



From the "sheath and stand" time—*to the vehicle for deep space—Sperry automatic checklist equipment proves the word!* At early as the production stage, it gives the electronic signal that a unit is performance ready. On the pad, it says *OK to launch*; in flight, it insures performance. The blank bar symbols are equivalent as they are among the broadest and best-proven insulation to the military art today. Whatever the objective size or performance need, Sperry can meet it—*sounding any space.*

For challenging engineering and production opportunities in aerospace and guided missile systems call R. L. Huisberger at OANIS 8-8858, or send your resume to Sparco-Dick Co.

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unique with SPS will certify the  
confidence level of each precision machined part.

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**SPS**

where reliability replaces possibility



Who has both: 1.5 Mc recorder and 1.5 Mc tape?

**AMPEX**

We just don't like to leave things undone. Recently, our engineers developed the first 1.5 Mc per track, multi-track recorder—the FR 1400. Like every Amplex recorder, it gives you outstanding performance. We felt we had to develop a tape that equaled the FR 1400 in quality of performance. Hence Amplex 9101—a 1.5 Mc tape. This new tape is a high resolution, heavy duty type with excellent wear characteristics. It offers high reli-

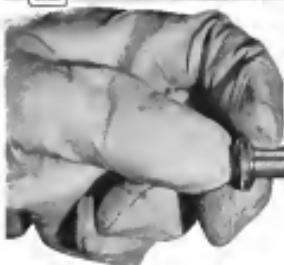
ability and superior performance. And can record 1.5 Mc of data at a speed of 120 ips. Amplex 9101 tape rounds out a recording system that gives you the highest frequency in longitudinal recording today. For more information write the only company providing recorders, tapes and memory devices for every application. Amplex Corp., 934 Charter St., Redwood City, Calif. Worldwide sales and service.



**AMPEX**



MISSOURI SWITZER FEDERAL RESERVE BANK



For industrial panels,  
service vehicles,  
tractors, cranes, etc.

**NEW!  
SERIES 5**

### **Heavy-Duty Pushbutton Switch**

Rugged Series 3 pushbuttons are triple sealed at panel to keep out dust, dirt, dust, dirt and moisture. Units withstand high G shock, are corrosion resistant, provide dependable service in temperatures  $-40^{\circ}$  to  $+160^{\circ}$ F. Round or square operating knobs take labeling, have long operating plunger to allow push even when operator wears heavy gloves. Bell-return, push-pull, encapsulated or alternative actions.

19 DIFFERENT BASIC SWITCH UNITS provide wide variety of control units in sufficient basic units. 16 combinations of basic units are possible.

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A DIVISION OF HONEYWELL

10. 1949年1月，蘇聯和中國簽訂《中蘇友好同盟互助條約》，蘇聯對中國的經濟援助開始。



Must command  
communications  
be vulnerable?

Command and control communication systems and electronic warfare systems meet the tests of survivability, reliability, and mobility. Electronic Communication Research has given ECI the capability to design and develop communication systems that meet these tests.  $\square$  The Strategic Air Command's Airborne Command Post communication system is a demonstration of this capability. In the most difficult environments, the air dispersed system maintains a simultaneous contact within the SAC commander, the numbered air forces and other major commands. Flying around the clock, command post planes give SAC the ability to order and deliver a retaliatory strike even though the main ground command post is destroyed.  $\square$  ECI developed this Beagle, highly reliable communication equipment in cooperation with the U.S. Air Force, and delivered the first system 11 days ahead of schedule. To help solve your communication problems, ask



GLOBAL COMMUNICATIONS, INC.  
600 Park Avenue, Flushing

# Major Breakthrough in Antenna Design



## ... thanks to Vickers Servo Drives

Using Vickers "packaged" electro-hydraulic servo drives, radar antenna designers are achieving major breakthroughs in the servo-drivetrain. In each case, these breakthroughs involve problems of weight, space, reliability, and cost. The results are more compact, stronger, improved precision, especially with high response and reliable speeds. Typical examples include:

**Heavy Applications (To 1000°/sec.)** On one massive tracking radar, Vickers servo drives provide accelerations of 30°/sec<sup>2</sup> for rotation up to 7,000,000 rad/sec.

**Great Speeds at Low weights (500000 RPM)** On the same application, the Vickers drives provide speeds from 2.5 RPM down to 500000 RPM. (A maximum acceleration of 40°/sec<sup>2</sup> is attained), an overall speed ratio of 500,000 to one.

**High Stays - Accurate Response** On a series of complex multi-axis tracking radars, Vickers servo-drives offer: Vectors Constants over 300 sec. d

**Lowest Weight - Vickers HP Range** Weights and volumes of Vickers servo

drives favor the antenna designer. For example, a 55 HP transmission has a weight, in HP ratio of 8.0 (HP and no envelope) of 4.04 cu. ft. (141).

**Smart Servo Design: Move Large Masses** On many antennas, servo signal and drives are limited to 10 rad/sec<sup>2</sup> (possibly 100 rad/sec<sup>2</sup>) and maximum forces up to 4,000,000 rad/sec.

**Universal Applications** Radials are virtually eliminated by using two to twelve motors to move. One or two of the radial motors can be used to move a main target on the periphery.

**Other Features** Significant advantages offered by the Vickers servo-drives are: high speeds - inherently high speeds - choices: servo and resolvers - low horsepower inputs - inherent overload protection.

•

If you are designing radar systems, systems or mounts, we would like to tell you more about these drives and our experience. Write for *Radar Drive Bulletin No. 1000*, Vickers Incorporated, Marine and Defense Dept., Worcester 21, Mass.

**VICKERS**

MANUFACTURERS OF ELECTRO-HYDRAULIC SERVO DRIVES  
VICKERS INCORPORATED  
Marine and Defense Dept., Worcester 21, Mass.  
1000

# Aviation Week & Space Technology

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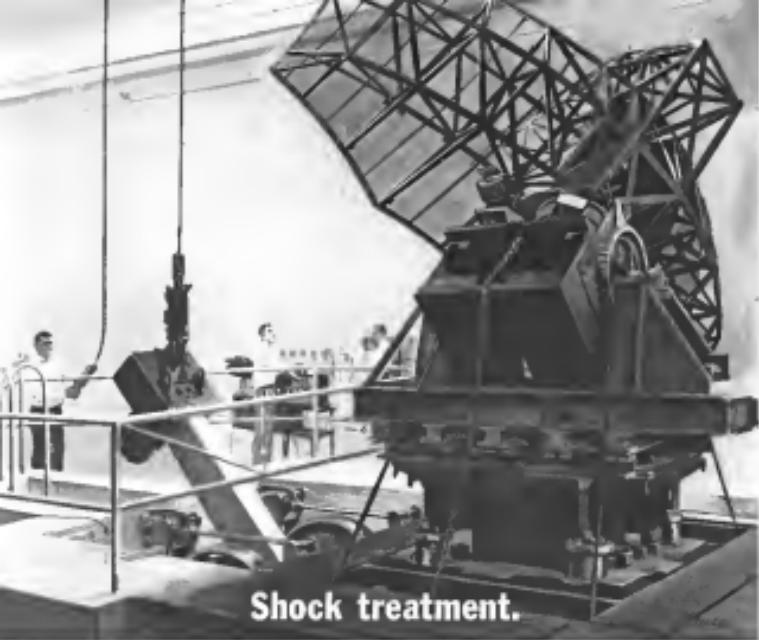
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## Shock treatment.

**Lockheed announces advanced environmental testing facilities available now to industry and defense.**

Successful on-the-job performance of components and complete equipment can now be assured by thorough reliability testing in one of the Earth's finest environmental laboratories. At Lockheed Electronics, test engineers check out simple and complex equipment through extensive environmental simulations ranging from upper altitudes to the mean floor. From sub-freezing to fiery hot conditions. From normal to violently explosive atmospheres.

Typical test simulating extremes of pitch and shock which a destroyer might experience.

Originally created to assure the reliability of Lockheed Electronics' products, the Lockheed Environmental Test Laboratory is now prepared to conduct standard tests or special evaluations for manufacturers of commercial or military products or equipment. Its technical staff can run single or combined tests to your specifications or your own personnel can attend and control. All results are documented in concise technical reports showing previous parametric environmental testing on projects classified through Secret.

For complete details write for a copy of Lockheed's first Test brochure, "Environmental in the Electronics... a service to industry."

Lockheed Electronics is the electronics gateway to survival. Thousands of scientists and engineers and technologists who work for Lockheed.

**LOCKHEED ELECTRONICS COMPANY**

PLAINFIELD, NEW JERSEY

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## EDITORIAL

### The Mid-Course Budget

The Fiscal 1964 federal budget confirms that the aerospace industry faces several heavy and protracted years (AW Jan. 14, p. 21). This budget calls for a \$57.3-billion effort in space technology, of which \$5.7 billion goes to NASA and \$1.6 billion for the defense space program, and about \$16.2 billion in the defense budget for research, development, test and procurement of aircraft, missiles and sensors. Both of these totals are探算 recent and reflect the need of the Kennedy administration to reallocate. In the aerospace field, the mood reflects a determination to face up to the increasing fiscal realities of the responsibilities the administration has assumed and to channel its effort toward the kind of priority goals it established earlier. In this respect it is a responsible budget, because as the military and space programs it should deliver what is required and promises of illusions and accomplishments are quickly reduced by fiscal sleight of hand.

In space technology, the high priority in the Apollo manned lunar landing program and the second NASA budget is oriented predominantly in the direction of the moon. This naturally means a reduced program in pure space science, and a less vigorous push elsewhere across the over-whelming spectrum of that reduced budget. There will certainly be pressure from Congress, the aerospace community and the taxpayers for that division of the available space dollar. But there can be no entitlement of the administration's claim of progress in this space budget. It is putting its money where its mouth is.

The budget's priority on the Apollo program for Fiscal 1964 during which it will absorb about 45% of the 1964 federal budget, is extremely significant. For while there is no guarantee of ultimate technical success in any budget, this is the case in which a budgetary failure could have crippled the Apollo program beyond repair. The critical technical work will be done after Apollo, but it can handle its most critical financial year of the first congressional verdict shortly mandating the administration's program. This level of financial support for Fiscal 1964 will at least assure that the star-spangled lunar capsule will stay in the race to the moon with the Soviet Union, whatever a budget in any year would guarantee a second place finish.

The \$31.7-billion defense budget (see p. 26) contains no surprise for followers of the Kennedy administration's defense policy and the philosophy of its defense secretary, Robert S. McNamara. It follows their original program of early increasing airpower capacity, increasing and modernizing non-nuclear war forces, including tactical airpower, and putting their major strategic force on parity with the Polaris and Minuteman solid-propellant ballistic missiles. However, the Fiscal 1964 defense budget does square several problematical homps that this policy has created and there appears to be a budgetary reconciliation in any of the key programs the administration considers vital. There are massive increases and bold downs in programs other people, including leaders of the military services, feel are vital—in fact, some \$13 billion worth of increases.

However, much critics of the Kennedy defense policies

may disagree with their goals—and we won't enter several disputes—they will find it hard to criticize the Fiscal 1964 defense budget as a responsible effort tailored to implement these policies fully and achieve these goals. For example, both the long-protracted items for completion of the Army's weapons modernization program and the enlargement of the USAF Minuteman force could have been reduced in the current budget, and stretched over several years to keep this budget much closer to the \$30-billion plateau the Kennedy administration originally envisioned. This would have significantly delayed the combat capability sought from both programs. But the full fiscal impact of these programs was absorbed in this budget to obtain the combat possible combat capability.

Indeed, in view of the budget's anticipated defense of the manned aircraft space, some years ago, by some ideal prophets of the missile age, the latest single priority item in the defense budget is approximately \$6.8 billion for aircraft. Many programs in this category are what the former officials term "a waste bin" for the McDonnell F-101 fighter aircraft for both Navy and USAF and the Lockheed subfins for the F-4D, the F-4E and the fighter jet C-141. Many programs in the \$4-billion missile procurement are the Navy's Polaris which will complete the program of 41 operational submarines in this budget, and the USAF Minuteman.

The \$5.7-billion research, development, test and combat includes \$2.3 billion for missile systems, including the advanced anti-ICBM Nike X, advanced Minuteman and new variants of the Polaris beyond X3, about \$700 million for aircraft, including F-105 and the XC-142 VTOL transport, and about \$1.5 billion for military space. (An additional \$300 million booster procurement and construction is listed elsewhere.)

Among the planes for the aerospace industry naming from the Fiscal 1964 budget are: Skyhawk the A-7D jet-powered administrative aircraft and the supersonic transport. There are some of the alternatives that had to be weighed against completing the Polaris and Minuteman programs at minimum price, giving the Army air lift capability and replacing the World War 2 transport with modern transports. There can and will be argument over some of these choices, but again there can be nothing but admiration for the man who made these hard decisions instead of letting the defense budget continue its 10-year drift in a yearly, ever-growing lump of relatively shapeless dough.

The magnitude of the federal budget for space and defense in Fiscal 1964 places a responsibility responsibility on the aerospace industry which will do most of the research, development and production of the hardware required. It will require clear hard-need management to discharge this responsibility to the taxpayer and nation, along with equal responsibility to their stockholders. And it places greater urgency than ever before on the government-industry partnership to find a workable system for adequately rewarding superior performance and punishing failure.

—Robert Hiltz



## **new war-club for nation's arsenal**

The Navy's Shrike missile is the first of a new breed of weapons designed specifically to increase air-to-surface striking power. Shrike will provide a new attack capability against heavily defended tactical target areas, combined with increased protection for the Navy's pilots and aircraft under operational conditions. Texas Instruments is the prime contractor for the guidance and control section of the Shrike missile, applying skills in electronics and aerodynamics. TI contributes to

The development of the high-performance weapon more than 20 years' experience in recognizing and solving tactical performance problems. ■ In addition, to the systems management of capabilities, TI possesses a unique combination of special skills in many areas of endeavor. Expanding from a broad research base, TI utilizes its various technologies to provide a continuous flow of improved products and services for its customers. ■ *With Department 48.*



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## WHO'S WHERE

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### In the Front Office

Jack L. Brember, vice president programs, Missile & Space Systems Division of Douglas Aircraft Co., Santa Monica, North American Aviation's Space and Instrumentation Systems Division, Downey, Calif., has named the following as vice presidents: Frank Coughlin—Advanced Programs Development; George Jellis—People and Programs Manager; Dr. W. R. Lankford—Advanced Systems.

## Honors and Elections

United Air Lines, De Havilland, St. Louis, NASA Office of Advanced Research and Technology, Prof. K. H. Miller, Massachusetts Institute of Technology, March 8, 1968, "Aerodynamics of the Convair 880." McDonnell Douglas Astronautics Corp., In: "Aerodynamics of the Convair 880," March 8, 1968, Seattle, Lockheed Martin, and Space Co., R. Dunn Spotts, R. Dunn Spotts Associates, George S. Tremble, The Martin Co., Walker C. Williams, NASA Manned Space Flight Center.

The 1968 Convair 880 Bell Award has been presented to James E. Bell, Research Fellow, NASA Langley, for his contributions to the development of the Convair 880, U.S. Army Avionics Center, Ft. Monmouth, N.J., "for development of the wind tunnel capture recovery introduced to service for the UH-1B during 1968."

The F&F Quaker New York Houses Ltd (United Kingdom) announced the award of a loanhead to James Diering Frères, chief executive and deputy chairman of Belli-Boyer Ltd.

## INDUSTRY OBSERVER

► Air Force Ballistic Systems Division has begun studying an extensive series of concepts for studies of ballistic missile concepts for new types of ICBMs that can be made available in the 1968-74 time period (ADM Nos. 3, p. 150). Convair Electro has been selected for a radio satellite guidance system study. International Business Machines and American Bosch Arma are participating in studies of the global ranging missile guidance system and AG Spacelab, and Sperry Rand for the command and control guidance system. Space Technology Laboratories will perform the long payloads study.

► Proposals for analytical and experimental studies of potential aerothermodynamic problem areas associated with Aerospacel Plane will be submitted to industry competition to Air Force's Aerautical Systems Division by mid-February for contract award in March. Programs, personnel detailed (AW Jan. 7, p. 23), will include development and testing of attack studies in a specific range of about Mach 8.5 to Mach 6.

- Probable reengagement of rules in the Apollo lunar landing program will have one of the two main numbers of the lunar excursion module (LEM) remain in the capsule to provide a communications link, between the second descent to the lunar surface and the returning mother craft and earth stations.
- British Subdelta B5-55-5 received thrust engine for the Hawker P1127 VTOL fighter will be delivered to Hawker Siddeley for flight testing this spring. The engine will produce 15,000-lb thrust. The aircraft has been fitted with 14,000-lb thrust engine since the Farnborough air show (AW Staff, 17, p. 54).

►Dong parameters of the Anny Nsiale Command's Lure mark. (Inset) Nsiale H6 anticipated an increased life-span capability, of about 15 years. During initial portion of ground flight, acceleration peak loads will not be less than 3.0g and may be high as 3.6g. Strong life of the profile rats as long as 10 yr, in a temperature variation from -51°F to +15°F.

► NASA has reported design studies of an electronic epicyclop gear complex to reduce new data from space flights and ground tests for the Manned Spacecraft Center anticipate data reduction facilities to be built at Clear Lake, Calif. New facility will handle large data sets reduction problems relating to the data reduction of the data from the space shuttle. The data reduction system will be used for the processing and other experiments systems. Copies of the NASA report are available for reference at Contractual Procurement Office, NASA Western Operations Office, Santa Monica, Calif., and NASA Headquarters, Washington, D. C.

► **Lunar Exploration Module (LEM)** being built by Grumman Aircraft Engineering Corp. for NASA will be designed to accomodate its astronauts without the requirement of a lunar logistics vehicle or descent navigation aids, such as horizon or television. Design will be kept flexible enough, however, that LEM will be able to use those other systems if they are developed in time for the initial landing and if it is felt that they will contribute to the overall probability of success of the flight.

► NASA is planning to install appropriately in disks and lights of the go/no-go type in the Agena stage to be used in rendezvous maneuvers with the two-man Gemini spacecraft. This instrumentation will subserve to the Gemini crew the condition of the Agena, after rendezvousing and docking of the two craft has been accomplished. They will show how much fuel remains in the stage, gas pressure levels and the status of electrical, hydraulic and pneumatic systems. By monitoring this instrumentation on the forward end of the Agena (the end which meets to the Gemini spacecraft) NASA will eliminate the requirement for an electrical interface between the stage and the spacecraft. Distance between the disks and the Gemini crew members will be about six feet.



## Army XV-5A\* provides maximum range/payload

Scheduled to fly in mid 1963, the Army XV-5A\* tilt fan research aircraft will provide greater payload/range capability than any other high performance V/STOL system.

Now being designed and built by Ryan Aeronautical Company, under contract to General Electric, the XV-5A\* aircraft will be powered by two .85 jet engines which drive submerged wing fans for vertical flight. This unique concept provides two to three times more lift, for a given amount of installed engine thrust, than any other high speed V/STOL design.

Result: Greater payload/range capability—less fuel consumption and need for logistic support. Because the lift fan system multiplies engine thrust by 300 percent, for vertical flight, XV-5A\* engines can be used for more efficient hovering and cruise conditions and do not have to be oversized to meet V/STOL flight requirements. These inherent and designed advantages give the XV-5A\* performance which meets anticipated requirements for military missions.

\*FAR 18.11

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## Washington Roundup

### Soviet Nuclear Threat

Soviet scientists "have worked out a 100-megaton bomb" but their calculations show that it "must not be used in Europe" because the explosion would affect East Germans and several other countries, Soviet Chairman Nikita Khrushchev told the East German Communist Party congress last week. The weapon can be, and "will cause, the annihilation of Europe," Khrushchev said. The yield of 100 megatons is a limit only from the point of view of military efficiency, he said.

Khrushchev said estimates by foreign scientists and military experts are that the Soviet Union has more than enough of this stuff. What would happen if all that nuclear armament were dropped on human heads? At the result of the first blow alone, 700 to 800 million people would have perished. At the end of the first blow alone, 700 to 800 million people would have perished. All the big cities would be wiped out or destroyed not only in the two leading nuclear states—the U.S. and the Soviet Union—but also in France, Britain, Germany, Italy, China, Japan and many other countries.

### New AIA President

Karl G. Harr, Jr., a 40-year-old New York lawyer who served as defense and security policy under the Eisenhower Administration, has been named president of Aerospace Industries Assn. He is expected to take office about April 1. The group has been open since last May 15, when August C. Buschow retired because of ill health. George F. Hammann, vice president, has been acting president. Since 1961, Harr has been associated with the law firm of Bogen, Boggs & Harr in New York City, working with clients in the aerospace field. He was special assistant to the undersecretary of state for administrative, legal and economic services of defense for continental interests, liaison and special assistant to President Eisenhower for security institution construction between 1959 and 1961. Harr is a magna cum laude graduate of Princeton University, a graduate of Yale Law School, and obtained his doctorate at a Rhodes Scholar at Oxford University.

U.S. and Italian officials have chosen the model of two Italian-owned Jupiter intercontinental ballistic missile units from Italy as a part of the modernization of North Atlantic Treaty Organization weapon systems. Jupiter's target probably would be assigned to Polaris submarines.

### Space Council Funds

National Aeronautics and Space Council is asking for an operating budget of \$525,000 for fiscal 1964, a decrease of \$5,000 from its current amount. The total will remain at \$2, \$2,000,000 of the request is for salaries.

Dr. Edward C. Weil, the council's executive secretary, continues to be outspoken on space expenditures and other controversial subjects. Referring to statements from more common to the cost of the space program, Weil told a luncheon audience last week: "These are bound to be sharp people in every field, just because they're labeled scientists doesn't eliminate them from being sharp."

Lockheed's IIFstar and a North American A-5A will be used by National Aeronautics and Space Administration in the coming year to study supersonic transport operating problems. NASA is buying the IIFstar to modify it for use as a versatile stability aircraft for control studies. It will be delivered in July. The A-5A was built from the Navy and will be used in studying problems of the transport crew and air traffic controllers during takeoffs. Both aircraft will be based at NASA's Flight Research Center, Edwards, Calif.

### Telsat, Relay Hearings

Testimony of the American Telephone & Telegraph Telebit and Radio Corp. of America-developed Relay communications satellite will be explored by the Senate commerce committee at a public hearing Jan. 19.

A week later, the 13 Incorporated of the Space Communications Corp. will be heard by the House Corp. on the economics as well as the technical aspects of a world-wide operational network. Rand financed the study itself.

Outlook of the new NASA budget request (see p. 29) is a \$5-million increase to begin work on Electronics Research Center in the Boston, Mass., area, which is expected to cost \$50 million and employ 2,000 eventually. NASA has no other center devoted solely to electronics, among its 17 installations.

Senate Adlai Stevenson is trying to create a national aid program for colleges and universities into its space and defense efforts, which may result in many of the aerospace Congress has to grant direct aid to schools. Legislation is being drafted to implement school aid recommendations of the recent House's Senate Adlai Stevenson report, which said that "increasing shortages of talented, highly trained scientists and engineers threaten the national well-being of vital national enterprises." NASA also is developing a large program for encouraging scientific and engineering training.

—Washington Staff





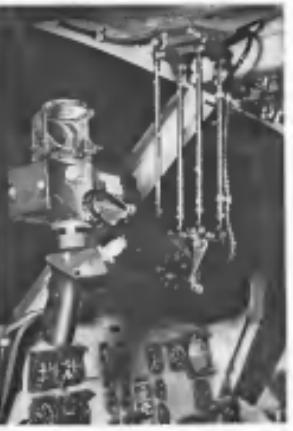




One of 26 Bell UH-1D Iroquois helicopters fitted with Emerson Electric M-601 gun mount installed in its delivery to Army's Utility Transport Helicopter Company in South Vietnam. Army presently has 11 UH-1Ds in South Vietnam.

## Bell UH-1Bs Fitted With Traversing Turret

Target mounts in UH-1B carry four M-68 7.62-mm machine guns (one on each side of the fuselage) which fire the short NCO-40 cartridge (AW) 1000-1200 rpm. Gun can be traversed from 45 deg. inward to 70 deg. outward, depressed 65 deg. and elevated 9 deg. Radar, communication and vision is shown. Gun tube left guides from base magnetite lens through tubes from sliding door to be closed at flight. Stabilisator is out of view in this photo, has been deleted in production models. Total weight system, including gun mount equipment and gun barrels is approximately 300 lb. For combat vision right side built in Emerson Electric, is mounted from cockpit overhead via cockpit flight side of cockpit. Electronically operated vision panels capability to track target without the need for being traversed instead of. Podded guns and tank guns. Emerson Electric's concern is that on the weapon head more than \$3.5 million. System can be quickly removed by pulling bolts at cockpit frontons to each side of the helicopter fuselage.



ARMED WIRE & SPACE TECHNOLOGY, January 21, 1968

## West Germany Cancels T-38 Plan

Some West Germans are loathe to cancelling long-standing plans to order a quantity of Northrop T-38 two-seat advanced jet trainers in the wake of a decision to transfer the bulk of its combat pilot training activities to the conventional U-8.

Under the plan submitted by Lt. Gen. Werner Pfeiffer, now an Air Force inspector general, West Germany will abandon its buildup of a advanced training program in a move designed to save both time and money (AW Sept. 26, p. 99).

At an estimated rate of about \$60 per jet, the air force's new cadre will be sent to the U.S. for approximately 10 months of flight training by U.S. Air Force instructors. Probable training site is George AFB, Calif.

West Germans at the air force originally envisioned a plan to follow through with the purchase of 10 T-38s, leaving them in the U.S. for use by West German pilots, but later decided to have them sent to Germany. Now, the students will return to USAF's T-38s and T-39s, with West Germany paying for the training and use of the equipment on a contracted package basis.

Upon their return to West Germany, the pilots will be given 25-30 hr. of navigation and all weather flight training before being assigned to transition into operational aircraft.

## New Missile Site Helicopter Bids Sought; Requirements Are Eased

Washington—Air Force has relaxed stringent requirements for its HX-1 airfield support helicopter in a bid to attract bids for the contract and to ease the use of subcontractors. Proposals are due Mar. 15 and a winner is to be selected in April.

Kaman Aircraft Corp., Bell Helicopter Co. and Sikorsky Aircraft Division of United Aircraft Corp. were told that their proposals, submitted last month for an off-the-shelf, single-engine, 16-passenger helicopter that did not meet Air Force needs.

Original specifications, sent to weapon systems bid November, allowed no substitutions of later engines, different

radio equipment, etc. In the original SOR-106 which had to the HX-1, the Air Force wanted either a helicopter or a fixed-wing aircraft to do the same use requirements. Technical differences in requirements were reached when a decision was made to specify a single-engine helicopter in the medium weight range.

While the specifications were being drawn, the Air Force designated the aircraft the HX-1 for budgetary purposes. The fiscal 1968 budget included \$6.6 million for the purchase of 25 aircraft.

To save money, it was hoped that a helicopter already in production could be bought. The Bell UH-1, Kaman HH-43B and the Sikorsky S-61 came nearer than any others to meeting the qualifications.

Air Force is also negotiating an HX-1 bare-helicopter option to a missile site support program, after amending Jan. 7 that it would close in Texas. Texas is one of two locations of Malmstrom Air Force Base in Montana. The HX-2 option was intended to support the towers (AW Jan. 2, p. 68).

The Air Force attack has brought on two engine Sikorsky CH-38 helicopters to service the missile towers. These have run into trouble, however, the New engine developed SOR-106, the New engine Sikorsky CH-38A, and the New engine Sikorsky CH-38B, which was available. Now that the CH-38 has been rejected, the additional 22 aircraft to be bought will be modified versions of the Sikorsky S-61B, transport which has a larger fuselage. It will have doors for air landing, and will be designated CH-3C.

The HX-2 program augmented from SOR-106. In the first competition last year, the Air Force announced that the Vought CH-46C had been chosen for the tower support mission. It was later

changed to the CH-3A when it was found that Vought had not met all delivery schedules and cost targets (AW Jan. 19, p. 40).

The term HX-2 was originated for budgetary purposes. In fiscal 1965, \$11.2 million was allotted for HX-2 as such. The budget total of 25 aircraft results from reprogramming of funds available in fiscal 1961 and additional requests in the fiscal 1964 budget requests.

## Compulsory Defense Arbitration Law Urged

Washington—Sen. John L. McClellan (D-Ark.) last week urged legislation providing compulsory arbitration of labor disputes at defense plants and installations in situations at the Boeing Co. and Lockheed Aircraft Corp. approached cross-stages.

A strike at Boeing set for midnight Jan. 15, was averted at the request of Wilson Siskin, director of the Federal Mediation and Conciliation Service. McClellan and likely agreed to measure to stop quo and continue negotiations at least until midnight Jan. 15 (AW Jan. 10, p. 1).

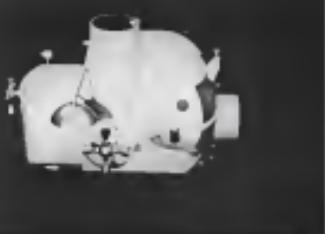
Meanwhile, what has long been the final negotiation attempt at the Lockheed site failed. Under Taft-Hartley Law, a vote is required on a final agreement proposal in scheduling during the first 14 days of February. Since Taft-Hartley was enacted in 1947, the pattern has been for workers to reject the first offer. The Lockheed dispute, the only successor issue in which the law has been in effect, will be a test case for the industry.

Sen. McClellan stated in a speech on Jan. 8 that at that the end of the 14-day period, management's proposal, which was available, faced the Lockheed committee last Dec. 31. "There will be no authority under existing law to which to assign the continued problems of the defense industry and our principal anti-inflationary assault. I submit that this situation should not permit us, either, to be dissatisfied and possible, to turn executive to then impeded."

In the past, compulsory arbitration has been adamantly opposed in both management and labor.

Sen. McClellan reported earlier results of a poll, conducted by 67,547 men in a long, in-depth poll during 1967. First in the category, field over 2000 firms, 55.43% favored law. The public opinion, AW 47-202, was a close call. National Association and Space Administration's Marshall Space Flight Center and Army's Manned Environmental Headquarters, 56.00% and 56.00% respectively, favored law.

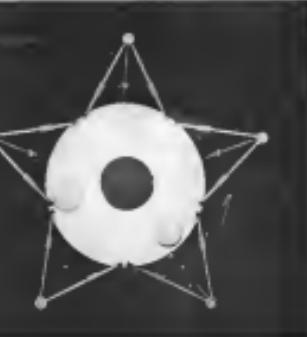
The HX-2 program augmented from SOR-106. In the first competition last year, the Air Force announced that the Vought CH-46C had been chosen for the tower support mission. It was later



## Model Photos Show LEM Configuration Details



Lunar excursion module (LEM) being built by Grumman Aircraft Engineering Corp. for National Aeronautics and Space Administration will consist of two basic sections, which will separate when module leaves the Earth's vicinity for the Moon's trip to Earth. AW Photo 28-360. Total height of upper MFT (module) section varies according to three 17-ft tall LEM's in choices upper right containing lower structure which contains descent engine and landing gear. The structure serves as a landing bracket and a left behind. Models of various features in photos give relative size of vehicle. Both top photos are from the LEM's right. Photo at left is of LEM's side. Large cross-clamped objects with bell nozzles are reaction jets for control. Telescop. antenna, visible in most pictures, are for radio communication. Small surface mounted jet behind top east port is for maneuvering craft between LEM and astronauts walking on the Moon's surface. Front view of LEM is shown below right. Note perforated technique below front east port which is one of the features to be used in landing. Bottom view of LEM below left shows two cross-clamped landing gear and descent rocket or laser port in center. Ditching object mounted on bottom is a radio altimeter antenna. Object mounted on end of left side of vehicle is a television camera.



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## New NASA Management Concept Aims for Higher Centaur Reliability

**L**os Angeles—New Centaur management philosophy should bear fruit in the late 1960s, says Alvin Silvestri, director of National Aeronautics and Space Administration's Jet Propulsion Laboratory. The laboratory is to hold user/100% reliability into the program and meet the recently planned operational schedule of soft-launching a Surveyor spacecraft on the same as early as 1967.

In the future, Centaur liquid oxygen/liquid hydrogen stages will not be flight tested until the probability of success approaches that needed for manned space flight. Silvestri said. Present success probability of Centaur has as its present value a collection of individual items in which a percentage of failures is acceptable. He said, "above the higher reliability level, extensive check-out testing programs will be required to solve all technical problems on the ground prior to flight."

"We can have safety factors based on the ground, but we can't in flight," Silvestri said. "If a test vehicle fails to return during a ground test, it can be taken down and inspected, but if it fails in the air, there is very little to do, with the object."

In addition to extrapolation of a range of test programs in quality control, a configuration control test facility will be set up at Goddard Space Flight Center for integrated checks of the Centaur stage/payload and booster prior to shipment to Cape Canaveral.

Test facilities will provide continually the stage performance checked in flight. This should allow better utilization of launch pads at Cape Canaveral as well as more accurate successful launches, which are necessary to save scarce windows of launch seasons.

Projected development schedule of the Centaur is to have the first flight and development flight during and immediately after the Surveyor flights should take place in the fall of 1969 and vehicle should be operational in 1971 for the proposed Surveyor shot 50 cent.

A single segment 156-in. dia center comprising a reusable orbital module and a 16-in.-dia aeroshell will be used. This includes aeroshell frangis.

The program also calls for two frangis of the 156-in.-dia center at 1-eighth the thrust with single segment motor using jet-thrust vector control.

Most of the 156-in.-dia tests using single segment propellant will include lifting and slowing the stage to re-orientation tests. Several additional non-ignition tests will be conducted on the upper 100-in. propellant. As a result, the three-stage nozzle will be fabricated using the technology of 1967, and then when most sensible the two outer thrust-train characteristics of the

on the Atlas. An increased payload capability will result from the decreased separation mass, since the gravitational effect on the vehicle is lessened. To insure efficient pump operation during Centaur lightoff, more efficient plumbing childhood will be evolved.

• Most efficient and user attachment of retrievable propellant tanks to the Centaur stage will be provided by low pressure air flow system on the side of the module. Loss of a panel due to higher internal pressure was responsible for the last failure of Centaur (AW May 26, p. 13). Insulation panels prevent excessive loss of fuel during launch and flight operations.

• Attainment of desired high reliability and solution of the difficult design problems inherent in the liquid hydrogen/liquid oxygen Centaur vehicle within the planned target date was resolved in a DPA process for testing and materials procurement (AW Oct. 8, p. 40).

## Large Solid Motor Bids Sought

**W**ashington—Static firing trials of 10 10-in. solid motors, 250 sec. total propellant burners are called for in requests for proposals next year for seven companies for the TE-15 test firing to be conducted for the last half of 1964 (AW Dec. 17, p. 31).

The test program, an outgrowth of a 10-in. 10-in. static test between Defense Dept. and the National Aeronautics and Space Administration, will also include firing of various configurations of 10-in.-dia motors to demonstrate the feasibility of applying segmented and single-pump propellant, monolithic nozzle, solid-state nozzles and jet tabs. Thrust ranges covered in the 200-in.-dia motor are 1000 lb to 14,000 lb.

One type of test will involve firing of a 190-in.-dia motor containing two center segments and a 2-foot-thick outer nozzle. The grain configuration will be designed to simulate the combustion characteristics of the 200-in.-dia motor.

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### Missile Ground Support

Industry proposals for a 12-month study to establish criteria for reducing costs and increasing flexibility of aerospace ground equipment for the missile market production systems are being evaluated at Edwards AFB.

Proposed systems to be evaluated in the study include reusable propellant resupply systems developing 100,000 lb to 5 million lb. upper stages using a propellant as high except storable propellants developing 10,000 lb to 100,000 lb and lower stages developing up to 200,000 lb thrust.

# British Emphasize Integration of Services

By Herbert J. Coleman

**London**—British defense establishment officials will make no major changes after the 1963 White Paper on defense in February with the exception of re-assessment of a pentagon-type group headed by one minister comparable to the U.S. secretary of defense.

At present defense is headed by Peter Thorneycroft, who has cabinet rank. The Minister of Aviation is headed by John Airey, and Hugh Fraser is in charge of the Air Minister, parent of the Royal Air Force. Lord Carrington is chief of the Royal Navy as first lord of the admiralty, and John Profumo heads the war office.

Potential changes in the defense staff of controllers of the Douglas-Boeing organization could result in a Royal Air Force Bomber Command with a separate existence.

In Parliament, important support is accumulating to keep a British defense staff independent of the U.S. or Europe. Toward the end, talks are continuing on

• **Bolting the Polaris submarine** and a total of 96 missiles at a cost of about \$1 billion and having them operational by 1971. There is some opposition to the Polaris fleet within Royal Navy, which has plans to build a new aircraft carrier and to develop a nuclear-powered plane for fleet. Both the carriers would be dropped to launch and recover the Hawker P.1154 supersonic VTOL-style fighter.

• **Stretching the Avro Blue Steel MR.1** missile boost to 350 m range, but dropping its effort to build the MR.2 version, which would cost \$93 m (AVW Dec. 26, p. 17). Although such initial missile budgets will not be revisited until after the White Paper on defense is presented to Parliament, this project is assured to keep the RAF V-bomber force operating until 1970, a task for the Royal Navy.

• **Reassessing a low-level long-range missile project** which was suspended when the then Defense Minister Donald Watson signed the Skidbladnir agreement with U.S. This weapon would be launched from either a V-bomber or the new TSR.2 strike-reconnaissance fighter and would fly at 400 ft, powered by two Bristol Siddeley ravage engines. Despite the cancellation, Bristol Siddeley continued target development and the engine made its first successful test had run two weeks ago. If retained, the weapon would be built in Bristol Aircraft Corp. as its Bristol Aircraft Ltd. plant in Filton, or by English Electric Aviation

Avro Vulcan 2 and Blandford Page Vickers Vandal 2, also in Filton. These and two others have a range of 1,000 miles. Vulcan was designed to take the Blue Steel and later Polaris, with little in terms of redesign.

At the moment, there is little chance that Great Britain will team up with France and West Germany to develop a European defense force. Anti-French feeling is strong on this issue. Profound de Gaulle threw his opposition to England entering the Common Market, even overshadowing the strong anti-American sentiment that followed cancellation of Skidbladnir.

However, Avro has had useful talks with the French government on the Tornado, the first of the series this year on re-equipping the RAF with a supersonic fighter-bomber and possibly both RAF and Royal Navy with the Hawker P.1154 supersonic VTOL strike fighter, and this adding to the 1963 defense budget is appreciable.

Probable cuts in the defense budget is being considered on extensive talks now going on toward reorganization of the

## Hawker, Northrop Sign VTOL Contract

London—Hawker Aircraft Ltd. has concluded an agreement with Northrop Corp. to provide a potential U.S. production capacity for its Hawker P.1154 VTOL strike fighter (AVW Sept. 17 p. 54).

Agreement was for the collaboration on the vertical take-off aircraft field. Hawker will furnish Northrop with the technical data and design information on the P.1154 and the follow-on P.1156.

Hawker's long-term interest in getting U.S. Avro is evaluating the aircraft in collaboration with BAEF and the West German government. Hawker Aircraft's position is not clear. B. R. Liddell Hart, consulting designer, is that the P.1154 will be built in large quantities in the U.S. and that the U.S. will manufacture the aircraft. However, an argument could be put forward on cost grounds. If an order is forthcoming, the two companies will be well-established in developing, after market, British and American aircraft.

Meanwhile, Rolls-Royce entered the British vertical-take-off strike fighter field by submitting a proposal last week to Ministry of Aviation to fit the P.1154 with two reheat thrust fighter powerplants (AVW Nov. 26, p. 17). Proposal was initiated by Rolls but will be evaluated by a committee headed by Avro.

At present, the engine for the P.1154 is the British Siddeley 605, a 100,000 lb thrust engine which features plasma chamber burning (AVW Dec. 14 p. 30).

Rolls-Royce philosophy is that this proposal comes in a piston engine that has reached 140,000 lb thrust. This requires that that addition of plasma chambers in the 160,000 lb thrust will boost that by 40%, 50%. Another factor is taken in that our engine is smaller for power in use, the other is not.

Rolls had previously done considerable work on the use of plasma rockets, some without any engine combustion (AVW May 10, p. 1). First studies indicated an engine with a thrust of 10,000 lb for the conventional spray. In a later stage, Rolls examined the different thrust spots at the West German VTOL market as a direct competitor to Bristol Siddeley's P.1154 through the BAEF technical agreement with MAN. No decision was made.

West Germany at first is attempting to obtain the P.1154 for incorporation into the Focke-Wulf 162 VTOL aircraft, subsequently lighter than earlier development. Avro also would use Rolls-Royce RD.162 jet engines in some during the vertical flight regimen.

Fokker-Wulf aircraft is seeking some redesigns in order to take up of reheat after initial development work by Grammer's southern subsidiary group on the VJ101/102 VTOL aircraft program, which probably will be dropped.

Major obstacle remaining availability of the P.1154 is lack of development funding. There is no British government money behind the project, and the West German air force may be less favorable for the program.

defense group. Base framework is being taken from the 1962 White Paper, which calls for closer coordination between the three services for more effective power and cost efficiency (AVW Mar. 5, 1962, p. 20).

Many of the external reorganization moves are being called for by Sir Alan Lord, Royal Manufacturing, chief of the defense staff. On his recommendation two air staff generals, Lord Justice, former secretary-general of NATO, will be re-appointed in 1967, and Sir Ian Jacob, one-time member of the war cabinet, has been invited to help in the proposed consolidations.

Alternative being discussed is a complete merger of the Air Ministry and

the Ministry of Aviation into the single ministry of defense, with the present structure remaining, with the Royal Navy and Royal Air Force. Another suggestion is a two-service system, with Army and Navy sharing portions of the RAF as well as some of their own.

This is unlikely, however, because of the difficulty of getting the services, although a strong group of air marshals, fighting the idea of a united-force RAF.

Major worry today for Britain is the missile gap narrowing from the Sputnik cancellation. This concern has caused the Conservative Party defense committee that the British-controlled deterrent will be strengthened during the gap period until Polaris is operational.

## De Gaulle Rejects Unarmed Polaris, Reaffirms Independent Force Plan

Paris—President Charles de Gaulle rejected the U.S. offer of Polaris missiles without nuclear warheads, as well as a U.S.-U.K. formula for creating a stabilized nuclear strike force within NATO.

De Gaulle demanded in detail political and technical reasons why France will not accept the so-called Nasir formula. He rejected the basic principle that France should not be controlled over its nuclear strike force.

Some de Gaulle, however, would be available for certain cooperative efforts with allied forces. But his thought of integration of and fusion remain inconceivable, he said.

De Gaulle, warning French attitude toward the Nasir agreement, highly resisted nuclear missile evolution under which the American warhead should be frozen. In French eyes, as longer rule for European defense needs.

Thus, de Gaulle, has taken place because Soviet weapons have advanced

so that the U.S. is now under threat of direct nuclear attack from Russia.

In the past, France could rely on the U.S. nuclear shield, since this force would be used without let of a Soviet nuclear strike against the U.S.

Now that this balance no longer exists, France intends to make use of its own nuclear defense of its own. All states, and the French government, have the same right to develop a nuclear打击 under their own French strike force.

Some de Gaulle, however, would be available for certain cooperative efforts with allied forces. But his thought of integration of and fusion remain inconceivable, he said.

While France intends to have an own nuclear force, de Gaulle added, this doesn't mean that will refuse to cooperate in operation with similar allied forces. Apparently de Gaulle was advancing the possibility that the French Basmati Mengh border force would participate in overseas training and other allied activities, though in no case would the French forces be under command over the other allies.

The French president also adjusted that his country's nuclear ambitions were again moving to Washington. He added and in order to encourage a strengthened military alliance enough appear to be the best possible status to the gods holding the monopoly he said.

On the other, the proposed multi-lateral nuclear force within NATO, de Gaulle said with an establishment of a nuclear alliance in France.

Regarding the U.S. Polaris force, de Gaulle said it had no immediate use since France probably has no nuclear submarine to carry the missile warheads with which it are there.

French refusal of Polaris could, as well as its rejection of NATO multi-lateral nuclear force, will remain a fixed point during the debate over West Germany's acceptance of principle of the consolidated force.

## News Digest

French government is planning a new missile-launching center to be located in the Southern region in an arc west France bordering on the Mediterranean. The center will be used to launch a European missile, which is scheduled to put the first French nuclear satellite in 1965.

Set for October last week became chairman of the French Space Agency, Jean-Pierre Séguin. He is a self-taught scientist. Sir Roy has been in use chairmen and takes over completely. New chairmen will be Sir Arnold Hall, managing director of Bristol Siddeley Engines, Ltd. Hall will remain a director and vice chairman of the engine company.

First satellite radio transmission between U.S. and South America took place Dec. 17 when a 12,000-watt broadcastr was beamed from Natal, N. J. via Relay to a mobile station at Rio de Janeiro, Brazil.

UK will provide four NASA-Cyrus rockets and one Nike-Hydrant rocket to India for launching satellites. The Indian, was the geostationary equator Apogee payloads will be established to study the electrical current along the equator and Cygnus payloads will be software input to trace the direction and velocity of upper atmospheric winds.

Second NASA-industry conference will be held on Washington Feb. 11 and 12 when 50 space agency program managers will discuss methods for reorienting fiscal conference in 1968 related to first measurement of the Apollo project.

General Electric's Space Technology Center received a \$187,000 letter of intent for a suborbital test and integration of the second-generation Nucleus satellite.

## LEM Propulsion

Revelations of propulsion schemes for the three components made by NASA's Goddard Space Flight Center and the LEM prime contractor, Grumman, revealed. Encapsulated into the components will be integrated and new reports of the project's results to solid rocket booster rockets.

This will allow Aerospace General and United Aircraft United Technologies Corp. a fresh opportunity to submit designs for replacement of the existing solid rocket boosters.

## Supersonic Transport Progress Stalled

**Budget provides no work funds; NASA ends research request; Halaby says study report is "incomplete."**

By James R. Ashlock

Washington—The development of a U.S. supersonic transport has become ensnared in federal budget rejections coming from President Kennedy's tax cut proposal.

Hopes that the program would receive expedition attention were dashed with disclosure that the President's fiscal 1964 budget contained no appropriation for supersonic transport work. The project was originally included in President Kennedy's influence on an budget message to Congress or postponement of more desirable programs as reported in his tax cut proposal. In the same message, however, President Kennedy and that he still felt supersonic transport development should

Industrials Action Agency also said that the tax cut would eliminate any funds available for supersonic transport development. The agency was authorized a budget request for supersonic transport development.

Hope also was dimmed that an Administration decision on the supersonic transport would be made in mid-1963, as predicted by the President when \$51 million was authorized for the project in fiscal 1962 and \$70 authorized in fiscal 1963.

Several Administrations and Space Administration has held off its administrative research and development until a basic design is completed and that it can go no further than specific design work, until NASA and industry have selected a configuration.

### Request Cut

Consequently, NASA cut its request for supersonic transport money by fiscal 1964 to \$3.8 million from \$4.3 million programmed in fiscal 1963. It is unlikely that any of these funds will remain in the program unless a more positive choice is made later this year.

The President's budget message came two days after an FAA report, prepared by a panel of NASA advisory group, was issued on the supersonic transport, holding it a "big priority program."

The advisory group headed by retired Air Force Gen. Orval R. Cook, said that "expedition development of a commercial supersonic transport will be the natural interest" and called for "full direction and encouragement" by the highest level of government. It proposed:

In a letter accompanying the report, Gen. Cook suggested the money be "followed at every vigorous action to obtain from the Congress the authori-

Mach 2.5 (1,180,260 mph), he concluded. Range of initial models should be 2,000 miles with a passenger capacity of 100-120 passengers. "150,000 passengers per year flight rate was recommended, with constant angle climb and a 10% gross operation of airports served made by large subsonic jet aircraft."

Certain technical questions remain to be solved. Gen. Cook said, "initial work should be done in house and involving contractors."

Development costs were estimated to total about \$1 billion. Aircraft should undergo flight tests in 1967 and be ready for commercial service by 1972. The panel said, "Price tag for each aircraft is estimated about \$10 million based on sales of 200 units." The program would cost, in regard most of the development costs through research on aircraft sold. Gen. Cook estimated that the results would be about \$3 billion per airplane.

Without citing specific, the advisory group said the results should be designed around "minimum operating costs consistent with safe, efficient operation." Ex parte noise level should be an "absolute" that that generated by supersonic aircraft at 10,000 ft altitude would be obtained, "that will result in noise experience at ground level that will be acceptable to the public."

### Anglo-French Decision

Concordance of these factors was a primary objective in the French and British decision to hold the speed of their joint transonic supersonic transport to Mach 2.4 (AV 12, p. 12).

Concordance requirements should be established early in 1963 and engine and airframe design competition should be held as soon as possible, the study group said. Two engines and two airframe manufacturers should be chosen in early 1964 to develop competing designs, and the final selection would be made out of the 1967 flight tests.

The two engines should be of the same size, but with different thrusts, however, with certain augmentation of both engines proposed and 1965.

Aircraft would have to be of steel, titanium or some other metal, the panel said, and, since Mach 2.2 appears to be the best point with aircraft maximum efficiency, "Mach 2.5 is not selected as the top speed goal because that is beyond the peak capability of turbine engines."

## Two KLM Directors' Posts Abolished

The Dutch-KLM Royal Dutch Airlines is changing its top management structure from two to a four-man directorate as a first step in its planned general reorganization.

More follows the resignation of KLM President E. H. van der Bergel and that of the carrier's four executive vice presidents (AW Jan 14, p. 14). The action also apparently conforms to recommendations made by McKinsey & Co., Inc., a New York management consulting firm, after a study of the carrier's personnel and operational structure.

New management will include at least one, and probably two, directors named from outside the company structure. One new member already has been named—H. L. Lauter, managing director of Shell Tankers of Rotterdam before his appointment, which will be effective July 1. The other post is to be filled through a search of the carrier's employee total of a great and lesser to present 2,800.

Other members named thus far are Frans Beusken, KLM deputy president under van der Bergel, and Louis de Block, the remaining executive vice president. Fourth member is expected to be named from outside the company as was Lauter.

KLM officials say that the Dutch carrier's future will be chosen from among one of the four new top management structure has been completed.

Appointment of Lauter is based on qualifications in other European airlines, which is prepared to step in and help KLM over its current financial troubles, possibly by taking over a share of the Dutch government's state holdings, which now represent 65% of the total stock. These reports were denied last week by a KLM spokesman.

## Subsidy Drop Is Shown in CAB Budget; FAA Seeks \$810 Million

By L. L. Derry

Washington—Civil Aeronautics Board production of a domestic transoceanic aircraft fleet based on local service interests was selected last week in a \$1 million decline in CAB's fiscal 1964 budget request. At the same time, Federal Aviation Agency said for an \$830-million budget for the same period, a \$33.7-million cutback was made.

At its budget hearing before the Committee, President Kennedy called for greater reliance on competitive free enterprise, with less federal regulation and subsidies" in the transportation industry, a position he took last year. He also reported a request for adoption of new charges for commercial and general aviation (AW Jan 22, 1962, p. 42).

The CAB budget request, which totals \$35.9 million, estimates that \$6.2 million will be paid the 14 local service interests in fiscal 1964, a \$3 million drop from the estimated amount for fiscal 1963. A \$3.7-million \$7.7 million has been asked by the three international airlines for fiscal 1964, compared with \$5.5 million for fiscal 1963.

Schedule paid to Alaska carriers will decline to \$9.2 million in fiscal 1964, compared with the \$8.9 million for fiscal 1963. International operations will fall to \$800,000 in fiscal 1964, compared with \$3 million this year. The 11 U.S. domestic airlines and the 17 international operating international carriers are not included.

These are the principal items contributing to the decline:

•Dissolving the \$5.6 million personnel pension fund for the operation of two new facilities in fiscal 1964. An additional \$4.6 million is being asked for improvements at the two locations, including the addition of seven new mobile lounge for Delta at a cost of \$2 million.

long-range routes have been funded during fiscal 1963 and an additional \$4 million budgeted for fiscal 1964. Funds for traffic control costs total \$26, with no more proposed for fiscal 1964. Extended Team facilities total \$11, with \$9 additional proposed for fiscal 1964. Extended Team facilities total \$11, with \$9 additional proposed for fiscal 1964. Extended Team facilities total \$11, with \$9 additional proposed for fiscal 1964. Extended Team facilities total \$11, with \$9 additional proposed for fiscal 1964.

•Abolished emphasis on the establishment and enforcement of Civil Air Regulations and on the airport ground safety program.

•Ending of the Air Mail Contract Information Service for the Air Force.

FAA has estimated that a \$500 million change on passenger, an additional \$150 on cargo airways will play a \$25 million per jet flight and in revenue from 2 years to 3 years per gallon of fuel for general aviation aircraft will yield the agency about \$150 million annually and help to cover operating costs of airports and airways.

FAA expects its facilities and equipment appropriation total \$27 million, an increase of \$2 million over the previous year. The request includes \$15 million for the evaluation of potential new buildings at the National Aviation Facilities Experimental Center in Akron City.

It also envisions \$12.2 million for the procurement of three Grumman Gulfstream aircraft and support planes.

For the first time since fiscal 1957, funds for the procurement and installation of air traffic control and navigation equipment declined. FAA asks \$99.9 million for this program, compared with \$117 million appropriated for fiscal 1963.

FAA, however, anticipates future increases in budget requirements as the new airports facilities are developed by the agency's research group.

For research and development, FAA has requested \$16.8 million, an increase of \$1.3 million over the amount appropriated for fiscal 1963. The \$5.9 million will be used for research and development in this manner. \$17.7 million for air traffic control and air navigation facilities, \$12.1 million for airports, \$9.4 million for research, \$2.1 million for regional and \$1.2 million for station medical research.

FAA, which has jurisdiction over the two Washington D. C. airports—Dulles International and Washington National—has requested \$5 million for the operation of these two facilities in fiscal 1964. An additional \$4.6 million is being asked for improvements at the two locations, including the addition of seven new mobile lounge for Delta at a cost of \$2 million.



**C-141 Fuselage Sections Readied for Mating**

Forward fuselage and nose landing gear of the first USAF Lockheed C-141 StarLifter turboprop transport are phased into position for mating at Lockheed-Georgia Co. in Marietta, Ga. These sections total 119 ft. in length, nose-to-leader will be 140 ft. after addition of rear fuselage and tail section. For earlier C-141 milestones, photo see p. 113. First flight is scheduled in December.

## CAB Must Rule on Panagra Ownership

Washington—U.S. Supreme Court has refused to dismiss what it says is the Civil Aeronautics Board's jurisdictional authority for handling problems arising out of Pan American World Airways and W. R. Grace & Co. ownership of Pan American Cruz Airlines.

In the decision issued last week after a 5-3 vote, the court reversed a District Court ruling that Pan American must divest itself of its 50% ownership in Panagra.

“We think the narrow questions presented by the parties have been extricated to the Board and that the complaint should have been dismissed,” the court order read. “Accordingly, we reverse the judgment and remand the case for proceedings in conformity with this opinion.”

Judge William J. Brennan, Jr. and Chief Justice Earl Warren cast the dissenting votes, while Justices Thurgood Marshall and John M. Harlan abstained.

The high court also said that the Supreme Court’s power to accept the case of the Panagra suit was “unquestioned.”

In the suit, CAB charged that Pan American and Grace owned Panagra in 1959 in 50-50 ownership and set up stakes whereby the two airways would not compete between the U.S. and South America. It also charged that Pan American and Grace conspired to monopolize air commerce between the eastern coastal areas of the U.S. and eastern coastal areas of South America.

Pan American also charged with using its 50% control over Panagra to prevent it from securing CAB authority to expand its routes from the Panama Canal Zone to the U.S.

It is alleged by CAB officials, such as its referee for Grace, to direct staff of the Panagra holdings.

It is clear that the Board has jurisdiction over radio power and can fix methods of computation, even though they originated prior to 1959, the court said.

“But we think the pre-1959 rules

may be in derogation of the regime established in the Act in so far as it concerns with the statutory standards for computation that it should be readjusted.”

Following its refusal to accept that the CAB’s jurisdictional powers are not limited to airways’ common routes other than routes to divert certain routes to the court said, “we do not read the set in any manner.”

“Where the positions lie within the purview of the Board, in so far as division of revenues, of revenues and the division of routes and the affiliation of common carriers with an entity Congress must have intended to give of authority to the Board to do with the rest of the board,” the court said. “So unless that is not such power exists.”

In its suit, CAB charged that Pan American and Grace forced Panagra in 1959 to 50-50 ownership and set up stakes whereby the two airways would not compete between the U.S. and South America.

It also charged that Pan American and Grace conspired to monopolize air commerce between the eastern coastal areas of the U.S. and eastern coastal areas of South America.

Pan American also charged with using its 50% control over Panagra to prevent it from securing CAB authority to expand its routes from the Panama Canal Zone to the U.S.

Disagreement over Panagra’s route extension is a key factor in the dispute over that line power in recent years between Pan American and Panagra.

It was a blow for the District Court case in which Pan American was held guilty as having violated the Sherman Act by supressing Panagra’s efforts to expand its routes.

Justice Brennan, in explaining his dissenting vote, said the court was establishing a bad precedent in its stand.

“On an action today, the court would give the Board the equivalent of untried control over Congress can hardly have contemplated,” he said.

Brennan was disturbed at the court’s refusal to take over the case which, he felt, clearly involved a question of antitrust violation. He cited other cases in which this court set the tone for him in Supreme Court afterwards.

“It is, we have open which to divide question of route allocations, territorial division and concentration of routes, economy and efficiency can not stand regulation,” Brennan said. “And here reflected in the court appear to intend to do practice of ratifying combinations between airways and other routes anticompetitive practices.”

“In what logic,” Brennan asked, does a company to its routes go to the heart of the regulation when there is a company to its sites?”

Brennan said CAB has jurisdiction for not proceeding against Pan American unless it can proceed against Pan. “But in all events, the court seems, is not to result in an absurd step in this already hideously prolonged legal fight,” Brennan said.

## CAB Cites Severed Wires in 707 Crash

Washington—Several wires in the cables into and out of the tail section of the Civil Aeronautics Board at the probable time of the May 1, 1962, crash of an American Airlines Boeing 707-328B at New York International Airport. All eight crew members and 57 passengers were killed.

The American report raised but largely said, “tail, rudder, and tail control had severed because of a failure of one or more of the raw conductors caused by a short circuit of exposed wiring in the area.

Investigators speculated that initial damage to the wiring may have occurred during two awards at the Brundage Corp.’s Eclipse-Premier Dr. Telephone, N.J. A windshear there was found to be more severe for positioning the eight-plate tail within the limit the report said, and CAB felt the wires were damaged by jolting.

It is believed that tensile strain in the structure of the wire, while exposed to the weather, had partially severed, to be jerked down and twisted to the extent that vibration and other disturbances over a period of time caused final separation,” the report said.

Inspection of the salvaged servo unit

inverted that two of the eight wires were severed and a third was kinking at right angles. None was severed at least only the continuity of the servo control, which is connected to the autopilot. But contact of the exposed wires would cause an effect that results in sudden, sudden vibration, either right or left, the report said. The American report added to the job investigation after finding wires broken after landing.

This appears to have happened at 1000512, 6 min. when the servos already already had acquired, evident the state of an atmosphere,” the report said. CAB investigators said that unless the flight crew detected the problem and made corrective action within a matter of seconds, servos would have been impossible in the 1,000 ft. of available altitude. Examination indicated that the rudder servo was damaged just prior below ground impact. The rudder servo did not fail 9 sec. after the initial. Tail was also damaged, but evidently not until 21 sec. after initial impact. Automatic disconnect buttons on both control surfaces were depressed.

Early inspection of the condition would have been hampered, the CAB said, and by disturbing references such as departure procedures, radio communication, flight deck, and cockpit, the servos might have been damaged.

“Given that the servo and radio unit fault was straightforward, CAB said, when damage occurs to that found on the American’s servo servo was disconnected on the wing of other units.”

The fact that numerous servo units were found on the assembly line with similar damage and markings is cited as evidence that the damage was initiated by assembly or



**First Jet Commander Prototype Rolled Out at Norman, Okla.**

First of three prototype 1000 ft. Jet Commander four-to-six place executive aircraft was rolled out at Avco Commander’s Norman, Okla., development facility last week. Aircraft is powered by four, 1,800-hp Pratt & Whitney JT4A-3 turboprops and will cost \$175,000 including basic instrumentation and standard interior. Production aircraft will be built at Bethesda, Md. (AWM Jan. 7, p. 39)

“maintenance operations,” the report said.

Officials of Braniff stated that the aircraft control was defense. They emphasize that the unit on the American cargo was delivered to Boeing in 1978 after passing all factory inspections, “and we haven’t seen it since.” Thus, unless that is the witness, the aircraft with the unit had been through three major aircraft overhauls. American’s cargo aircraft modifications had also been made in the six years since the unit was installed there.

Because of the attention focused on the unusual condition of the covering of the wing, and the wing itself, it is suggested to observe what the government might regulate as overhead repair.

## Seaboard President Attacks Case For Pan American-TWA Merger

New York—President of Seaboard World Airlines has denounced as “short-sighted” the reasoning expressed by Pan American World Airways and Trans World Airlines in their move to merge.

Richard M. Jackson, speaking before the New York Society of Security Analysts, and that only by authorizing antitrust actions preferable. Seaboard, to enter scheduled transnational service could the government protect the Seaboard and its passengers.

This would require the re-enterance balance which Jackson feels is vital to the public interest and the country’s international airline interests.

The principal Pan American-TWA argument is that the merger would raise the U.S. flag carriers’ participation in the transborder market from 54% to about 65%, because approximately that percentage of the transborder U.S. airline traffic is short-haul, the Seaboard World president said.

These point-to-point American transborder flights are a fraction of their total, which exceeds half of all traffic, and does not seem TWA or Pan American. It is reasonable to argue that the government must reduce the American airline’s share from two to one in order to increase the number of transborder flights selecting a U.S. carrier,” Jackson said. “If that is logic, it makes us.”

Jackson said the airline was for a commercial enterprise to increase its share of the market is to capture its sales and services, which he believes both Pan American and TWA have had ample opportunity to do.

“In fact, that is exactly what these foreign competitors have done, in the supposed detriment of the two U.S. carriers,” he said.

This brings up a pertinent question

— “Braniff. Deep spoliation and must be separated, and if they are dissolved in our unit they must be replaced. It is certain that the cut in the cost of the unit’s wing and another damage, but it has not avoided causing corporate abilities,” he said.

Jackson said his own airline, to that date the merger could have an U.S. cargo rate competing with TWA and Pan American.

The cargo unit will with its own domestic feeder and enlarged feeder could expand traffic which, plus Seaboard can compete for the coastal cargo.

“It could not be passenger transport by means of circuitous and other assignments, to attempt to bar Seaboard from a substantial part of its market.”

To justify the merger, Jackson said, the government must come three things—that the public is in danger of a choice of two bad U.S. international carriers, that the government doesn’t lose its authority to oversee the large commercial operations in a chosen market, and that the industry is strengthened by each carrier (Seaboard) is strengthened in point of fact have the postal competitive advantage of the merged airline.

“However, the public interest must be served through private interests, and the Pan American-TWA merger is proposed, not in the public interest,” he said.

Merge would, in Jackson’s opinion, let “a field of monopolies” on U.S. routes who would have only one of them a U.S. airline, and whose natural inclination is to choose their own flag carrier.

This argument is not accepted, and U.S. carriers are expected to have no more preference for a U.S. flag carrier. This is the stated purpose of the merger to increase U.S. participation in the transborder market from 54% to about 65%, because approximately that percentage of the transborder U.S. airline traffic is short-haul, the Seaboard World president said.

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This is not a radical idea, says Pan American and TWA’s principal contention was that transborder damage, in which it can affect degrading corporate abilities,” he said.

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Merge would, in Jackson’s opinion, let “a field of monopolies” on U.S. routes who would have only one of them a U.S. airline, and whose natural inclination is to choose their own flag carrier.

This argument is not accepted, and U.S. carriers are expected to have no more preference for a U.S. flag carrier. This is the stated purpose of the merger to increase U.S. participation in the transborder market from 54% to about 65%, because approximately that percentage of the transborder U.S. airline traffic is short-haul, the Seaboard World president said.

These point-to-point American transborder flights are a fraction of their total, which exceeds half of all traffic, and does not seem TWA or Pan American. It is reasonable to argue that the government must reduce the American airline’s share from two to one in order to increase the number of transborder flights selecting a U.S. carrier,” Jackson said. “If that is logic, it makes us.”

Jackson said the airline was for a commercial enterprise to increase its share of the market is to capture its sales and services, which he believes both Pan American and TWA have had ample opportunity to do.

“In fact, that is exactly what these

## Ethiopian Carrier Faces Jet Competition

By Robert H. Cook

out of the country in the north

and south, and in the west.

Now EAL’s domestic routes are operated at a loss, but without its foreign routes, the carrier might have remained largest of the state-owned national air carriers (AVW Jan. 9, p. 96).

Behind the airline’s successful 17-year history under three World Airlines management stands the unceasing support and reliable attitude of its great chief, Shale Selassie, I, who has seen EAL through from a black operation to one of Africa’s most respected and profitable airlines.

Another of just how strong this support has been is the fact that while the TWA group has only one member as the EAL board of directors, TWA representatives seldom go uninvited.

EAL is unusual among African carriers in many ways. It was not established primarily for national prestige or commercial gain from flag carriers, but for the express purpose of providing Ethiopia with its own practical method of cost control with the outside world.

The carrier’s personnel emphasized this and said that by 1965, 80% of EAL’s 1,000 employees will be African. It began as a regional airline to TWA, which signed the first management contract and began formation of the airline under a \$400,000 equity loan from the U.S. carrier. Ethiopian government and EAL stock is still owned by EAL (AVW Dec. 26, 1960, p. 32).

Slightly larger at total area than the 16 U.S. Northeast states, Ethiopia is blessed with a very good climate and topsoil, but is 12,000 ft. deep. However, a vast area of the country has been taken out of cultivation for degree of elevation. Now by elevation, there averaging 7,000 ft. the main peaks reaching as high as 15,000 ft.

Because of the rugged topography, logistic and railroad construction has remained at a minimum. There are only two short embankments in Ethiopia to date. One stretches up a steep, 8,000 ft. escarpment for 85 mi. from the hamlet of Mekelle to Asmara. The other extends from the French Somaliland port of Djibouti for about 600 mi. to Dire Dawa and Addis Ababa.

Paul, elsewhere logistic supply, railroad from Asmara to Addis for 150 mi. and about 200 mi. to the south. To the west, the road goes about 150 mi. to the other of Djibouti and Leopoldville. The balance of the country has only one road, especially even for four-wheel drive vehicles for areas most of the time. These tracks disappear in the mountainous areas to the west and the large desert area comprising at least

opportunities for the development of Ethiopia, which is the second largest country in Africa.

For many years, EAL recognized the fact that Africa had two types of routes: African routes, which have been the most profitable to the carrier in the face of burgeoning new competition from European and Asian carriers (AVW Jan. 9, p. 96).

The total necessary to action and expand these domestic routes is one of the primary reasons behind EAL’s international service and its recent acquisition of two Boeing 720B aircraft from the international routes extending from Nairobi, Kenya, to Athens, Istanbul and Madrid. The twice-weekly 10 hr. DC-8 flight has not been profitable, but Ethiopia believes the day when it will become one of the country’s most heavily traveled routes.

Although the airline quickly admits that it is not yet profitable enough to buy a larger and more advanced aircraft, it feels that efficient operations will enable EAL to meet the challenge for better than most African carriers. The jet aircraft are being financed on a six-year depreciation schedule.

Meanwhile, the airline has been an undeniable success, for since the first DC-3 and C-47 aircraft came into its fleet, it has earned a total net profit of nearly \$5 million, despite the handicap of the 1960-61 operations due to disastrous Right Bank flooding. The airline has a balance of \$600,000, 12 aircraft and a fleet of which are now quite large and strong.

Completion of one of these major facilities is not needed, said EAL, but as a means of encouraging its friend agreements with other nations so that Ethiopia can offer the reciprocal landing rights necessary for an future trading route expansion.

While the embankment development program will probably result in new competition for EAL, the carrier is confident that its efficient airline will have a road that overcomes these difficulties. Even now, Ethiopia feels that the greater the airline, the more traffic will be the



**BULK OF EAL DOMESTIC SERVICE** is provided by DC-8s flying on point-to-point routes outlined by shown. Technical shows are landing over a point-to-point route at Ganta before the Sooq border. Gage amounts for each of EAL's total domestic revenue.

We are heavily involved in exotic instrumentation.



### A case in point is cryogenics.

In modern, fully equipped cryogenic development laboratories, a unique combination of Bendix experience is needed to meet the most stringent instrumentation test requirements. Our experience includes 17 years liquid hydrogen, 23 years liquid oxygen, and 42 years—precision instrumentation.

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**Pioneer-Central Division**



Ethiopia, as are 15 out of 36 ground equipment employees.

Pilots have come from either the Ethiopian air force or the National Airlines Training Project, a segment of the Post Four company instrument provided by the U.S. Almost the only source of mechanics has been an ICAO training program, which has provided 30 mechanics from a three-year instrument course. Others have come from the service force, or a few from Post Four crews or from experience elsewhere.

At this time, the Ethiopian pilots fly most of the DC-9, DC-10, C-47 and CV-240 schedules and the majority of aircraft building on equipment supplied the time of EAL as it does on any U.S. airline. Six Ethiopian pilots have completed training with the Boeing Co. in Seattle, Wash., and TWA's corporate course at Kansas City, Kan., for future flight instructors. The only major difficulty, according to the service, has been in training flight engineers for the 737s.

None of the EAL engineers is our study unusual, but there is a rare degree of the engineer who belongs in the development of complete aircraft systems. In fact, engineers will migrate to the next aircraft. EAL considers this a wise move, for as one senior official put it, "It's better to consider an organized demand, than face an unorganized supply."

Bendix's role, the service has commented largely on developing an cargo business, which accounted for much of the 10% of total operating revenue in 1961. Coffee production and sales are the main cargo items and EAL hopes eventually to become a producer shipments to the point where Ethiopia can compete with Kenya, which then gain value in the larger Ethiopian coffee and the British preference of Arabica on the Red Sea.

Only a few days ago was impossible to export coffee growing wild in the one west of Jijiga, because of the lack of roads. Today, EAL has two C-47s on a daily schedule to that area for the months out of the year. It is a good source, as much as three tons of coffee a day will be transported by each aircraft.

On the same trip, the aircraft carry passengers, along with produce and a variety of items including guns and ammunition. A typical round trip from Maka, about 100 miles west of Jijiga, takes about 12 hours.

North of Jijiga along a 600 km. long mountainous loop with stone roads, distances exceeding 1,000 km. are covered in piles of white, jagged stones. Roads are equipped with radio stations and if we served the very road, including the rugged terrain, where living conditions are at their worst.

An unusual but important source of income to the service is the carriage of



**FIRST ETHIOPIAN AIR LINES BOEING 727 326** (top) takes off on its first International flight carrying 100 passengers from Addis Ababa to Rome. (Courtesy of ETIOLE)

a leaf plant called "khat." Considered a mild stimulant by the Indians, khat grows wild in the interior of Ethiopia and last year earned EAL \$860,000 under a pool agreement with Adwa Adwa. Some of the "khat men" at Dura, Dabat and other Adwa districts of the leaf as a source of income is indicated by the fact that its shipment raised over 25% in 1961 to over 1,000 tons. For the first 18 months of last year, that revenues approached \$780,000.

Possibly the most promising source of future revenue will be the development of Free Trade Areas at Dura, Dabat and Dyleib. EAL estimates this cargo will reach 60 tons a day and will consist of sugar, cotton and other raw materials, demands for which exceed exports beyond the country's capability. EAL has made a thorough study of the future of commercial aviation in Africa and finds that no further expansion can be undertaken until a majority of countries achieve some degree of political and economic stability. Many countries which it considered would be profitable in this time, while negotiating for others it complicated by the fact that less than half of the countries involved have planned for enough ahead to know what that would be the way of resuming profits.

One of the major plans desired by EAL for addition to its trans-Africa route was Adisab, in East-Central Ethiopia. At Adisab, a corridor of 11 former French colonies now operating their own airlines with the support of Air France. Although it gave trilateral rights to Adisab's holder, EAL nevertheless prevents license of the corridor of Air Afrique which has not ordered two Douglas DC-8 transports and has a route which overlaps the corridor to Khartoum in Sudan.

EAL fully expects better competition in the future on its trans-Africa route when the others two DC-8s flight a week. In April one flight will be operated on a weekly basis. The second is to place in May. In North Africa route of this time, and prefers to accomplish first an international route route by negotiating route extension

On the longer hauls, as they would be maintained by most carriers, these internal services are not profitable. However, EAL prefers to consider their total earnings in terms of cost of pooled operational costs. Reducing such direct cost share as depreciation, sonic resistance and aircraft overhead, these routes are profitable and will save due when sufficient revenue to meet all allocable costs. EAL management believes.

While the airline certainly serves as a banner of national prestige for Ethiopia, EAL officials are relieved that the service is not yet in a position to meet an unmeasured demands for more expansion beyond its current capability. EAL has made a thorough study of the future of commercial aviation in Africa and finds that no further expansion can be undertaken until a majority of countries achieve some degree of political and economic stability. Many countries which it considered would be profitable in this time, while negotiating for others it complicated by the fact that less than half of the countries involved have planned for enough ahead to know what that would be the way of resuming profits.

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out of Accra, Ghana, to West and Latin America.

Practical and fast charter, particularly on the long hauls from Europe to Africa, after the best opportunity for future profits, the airline feels. Plane ride costs on the company's three B747s average about \$2.80 per passenger for scheduled service and can be reduced to only \$1.20 on a charter basis. Utilization of the aircraft, which conducted one round-trip, seven European and two North American flights, was 80% in the 90 deliveries, which took 8 hr. a day.

While EAL has made admirable progress, it still must meet completion of the country's airports and savings tourist airfares. Construction of Belize International Airport is still behind schedule, even though the runways have been finished. Maintenance and overhauls facilities, which will prevent work on all aircraft, will not be finished until this summer, and all work will be on the Boeing 737-200s in now being delivered to Pan American. Settlement negotiations and may not be available until the end of next year.

None of this effort was created by chance, in that skilled construction workers are on the spot, and by competence of the European and.

Most of this earthmoving equipment is four hours, called "bottom out," extending as deep as 12 ft. During early periods, this soil would be a sponge, causing streams to burst and wash. To avoid this problem, some airport building foundations were first excavated at about 17 ft. and then filled in with rough aggregate before concrete racing could be poured.

Even then, the engine overheat shop, which was nearly complete, fell victim to this problem. The concrete floor bulged upward and had to be replaced.

## Small Airport Program

Waddington, a Virgin Island, is demonstrating the need of the nation's smaller airports for improved lighting, navigation and instrument approach aids has been launched by Air Transport Asia.

The program is intended to franchise officials of smaller airports and their community leaders with the improved airline service that could be obtained through the installation of modernized lighting, navigation and landing aids.

The program was to be presented to the Federal Aviation Agency for work with the request that the agency place maximum emphasis on the development of this one, unique and landing aids specifically designed for use on smaller airports.

The program is summarized in a small booklet entitled "Making the Most of the Smaller City Airport." Copies are available from ATA, 1800 Connecticut Ave., N.W., Washington 6, D.C.

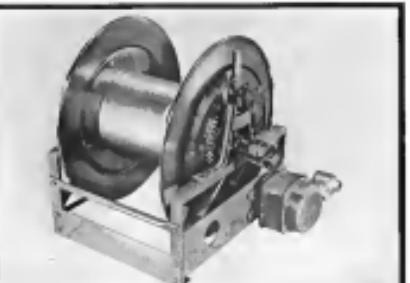
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# AIRLINE OBSERVER

► Eastern Air Lines has found that 17.3% of its AmShuttle passengers have been converted from surface transportation. In an Eastern survey, 9.6% of the respondents to a questionnaire and they would use a train or the Washington-NY-Boston route if AmShuttle were not available and 7.7% said that would use auto or bus. Total of 49% listed the automobile as their least used mode of transport in their decision to use the AmShuttle while only 5.6% gave price as a factor.

► Eastern Air Lines has increased its student fare discount from 25% to 40% increased eligibility requirements and made the cut rate applicable to more routes. The new promotional fares are available to all college students, including those taking evening and correspondence courses, high school students and persons enrolled at military or naval institutes. Flights may be made on all types of equipment. The student tariff was established as a traffic building experiment on Jan 1, 1962, and now appears to have a permanent place in AmShuttle's fare structure.

► Robert E. Pusch, president of Midwest Airlines, told the Civil Aeronautics Board that the carrier will welcome any revised regulation the Board may make. He added: "But I must point out that each air inroads will raise a cost in service to the system of which must be made in the communities that receive subsidized service." Pusch was emphasizing an indication by CAB that it is determined to get the book on local service airline subsidies.

► An AmShuttle type of operation will be expanded Mar 1 by Eastern Air Lines to include morning flights between New Orleans and Houston. The new service, called "Walk-On" flight, will feature no reservation, pre-scheduled, guaranteed seat and low cost. Chief difference between AmShuttle and the new service is that seats will be served on Walk-On flights and the new service will be available on all Eastern's morning flights, including jets, between the two points. No new flights will be added, but existing aircraft will be available to provide seat guarantees.

► Flight Engineers International Assoc. has asked CAB to withhold approval of the transfer of Mutual And Agreements funds from one organization to Eastern Air Lines. The union charged that Eastern never intended to make an agreement with FEIA, but planned a program to eliminate the Eastern chapter of FEIA by bargaining representation for flight engineers.

► Rolls-Royce has started flight on its Conway KREC 12 bypass engine from 17,500 lb to 18,000 lb. Specific fuel consumption has been reduced by 2% under all operating conditions. Alitalia has ordered the warmed thrust version to power two Douglas DC-8 transports.

► Capital of all 15 Soviet republics comprising the USSR now have what were jet passenger service. Soviet jet routes will be added on Vilnius capital of Lithuania, while Tu-114 long-haul transport aircrafts from Moscow were introduced last month.

► Domestic airline industry reported a 3.8% gain in revenue passenger miles during December, compared with the same month last year. Coach traffic continued to grow and showed a 12.7% increase, while first-class revenue passenger miles plummeted 47%. Available seat miles declined 11.2% to drop the load factor to 96.1%, well below the break-even level required by a number of carriers.

► United Air Lines' proposed one-class service (AW Oct 15, p 45) is drawing less scrutiny, opposition than anticipated. Russia said that the United plan could upset the continuing division of first-class traffic to coach.

► CAAC last week passed a tentative approval to Oly Leontaridis, Finavia AB of Finland to conduct charter operations between Finland and the U.S. Because the bilateral agreement between the U.S. and Finland could not be signed under time, the Board issued a show cause order asking interested parties to state reasons why a foreign air carrier permit for charter service should not be granted to Finavia.

## SHORTLINES

► Allegheny Airlines has received Civil Aeronautics Board approval to extend its main lounge in Cleveland round-trip fare reduction of 17.5%. The low fare, which originally applied at 5 p.m. Sunday, is now available between midnight Friday and midnight Sunday.

► American Airlines will until March will allow "Morning Soft" Lights (MSL) on its Boeing 727 turboprop transports. MSL uses a candleless incandescent lamp, similar to photographic strobe units, which can be set at a range of 5 m in daylight or 25 m at night. Three of the lighting lights will be installed on each wingtip, one on the tail.

► British Overseas Airways Corp. will begin a new weekly service between London and Dulles International Airport and Washington, D. C. on Mar 6. Services will be expanded to daily flights that summer.

► Canada's Air Transport Board has granted Molson Airlines operating rights between Buffalo and Toronto. Civil Aeronautics Board awarded Molson the route in December, 1961.

► Eastern Air Lines will increase its advertising budget by 11% in 1962 over 1961. Campaign will include extensive use of television for the first time.

► Frontier Airlines has signed a ten-year contract with its 185 planes. Basic fees were increased by an average of 4% per plane. Agreement runs until two months before old contract expires.

► Pan American World Airways will show an 18.5% increase in passenger traffic and a 22.5% rise in tonnage traffic for 1962, compared with 1961.

► Trans-Texas Airways carried 383,246 passengers during 1962, a 33.1% increase over the previous high year of 1960, when it carried 331,617.

► United Air Lines has been granted these overload time extensions by Fed. Aviation Agency, on its fleet of Vickers Viscount turboprop transports, engine from 4,350 to 4,500 hr, propeller from 5,300 to 5,500 hr, and gear cooling from 6,620 to 7,200 hr. These however, are subject to the Rolls Royce Dart turboprop engine at 3,500 hr.

► Western Air Lines has purchased three more Boeing 737B turboprop transports at \$5.5 million each, bringing its 7,000 fleet to 10.

## Simplified Power for V/STOL Aircraft

Traditional fighter aircraft have been given the nickname "flying bricks" because the total thrust can be used for both lift and forward propulsion. This presents the difficulties of a single engine installation in which separate lift engines, the propulsive engines, must be synchronized, solution that can be achieved with one combined mixed engine utilizing wind bypassing engines.

### HYDRAULIC INSTALLATION

► Simplified installation  
► Simplified aircraft design  
► The resulting thrust and altitude drag

through a fixed point near the the aircraft centre of gravity.

► A large thrust linear or supersonic duct with a small aircraft engine is used for lift and forward propulsion.

► Availability of a large jet engine, known for its acceleration and mass flow rate.

### HYDRAULIC FLIGHT

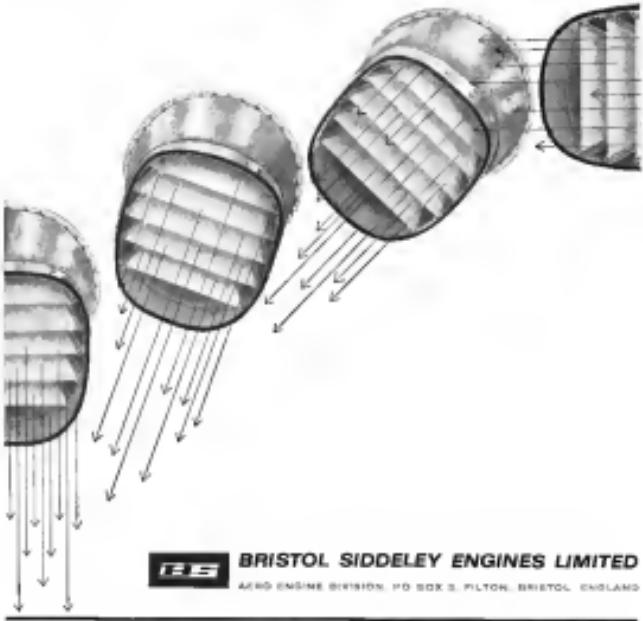
► Fixed ducts with lift thrust mechanism fuel can be bypassed in the bypass ducting or bypass chamber to give a thrust burst for take off.

► Greater thrust for takeoff, acceleration.

► Greater radius of operation.

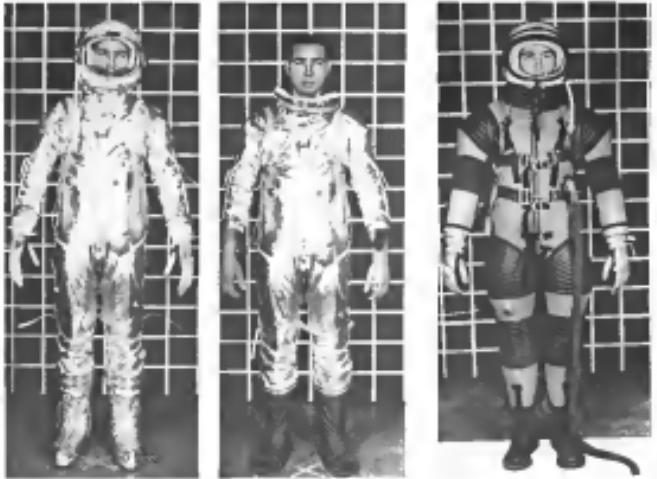
► More efficient aircraft design.

► Larger propulsive thrust available for take off.



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## First Photos Show Gemini, Apollo Space Suit Details

Ground proximity space unit developed by the E. F. Gosselink Co. for National Aeronautics and Space Administration specifications is built by half units in complete form (half and half) which are connected side and both rounded interior. Cells and boats can be removed by cutting through padded interior flight and are designed for rapid disassembly in the event of return from space. Seven seats in the crew of the unit can be lowered by crane during the flight and closed rapidly in emergencies. Seats are the seat and all seats are well padded and soft and the two instruments are set on the rear. On Gemini, similar "Caviness" of instruments will be gathered together in one compartment in the rear of the instrument panel. The use of the two seat units provides a safe place for the emergency ejection of the entire crew of three. Ejection is required by the code of Ethics in the selection of a contractor to build the Gemini unit. At present, these companies—Goddard Space Flight Center and Clark Corp. have contracts. Ballistic type seats that will be featured on the Apollo program and are expected on the experimental space unit at night. Seat shells are lined as a fibreglass—UHMW plastic but not the Apollo seat. Belts are balanced so that a constant tension is maintained during all seat, leg, torso or head movements. In building as, for example, the ballistics point constraint on seat belt, belt is exposed to optical sensor on the opposite side, thus maintaining the same initial tension throughout the flight. Caviness states the seat will be able to support only normal weight in deep space mode, but will be pressurized to 100% oxygen to 15 ps. Due to the fact that the life limit precludes use of oxygen oxygen gas embolism, use of pressurized oxygen usage, that will be

## MA-9 Experiments Vital to Rendezvous

George Alexander

Houston, Tex.—Space Shuttle experiments planned for the ninth Mercury test flight—now tentatively scheduled for 1979—reflect increasing emphasis at the National Spaceport Center here on the collection of engineering data for the development of rendezvous techniques. The center's primary program is planning on a continuation of 15 orbits for Mercury flights (9 M/S, 9), with a decision to be made at that time on continuation of the flights up to 22 orbits (14/15 Dec. 1978, p. 23).

Pilot management of the MSA-9 space-qualifications, the efficient utilization of all in-bound resources—in this case, task of the mission assigned to SCAF Msc. Gagarin Cooper. The experiments are expected to provide data needed in the Gemini and Apollo programs. Experiments include:

Testing proposed flow, A-10 is to use a 100 ft. long section of the proposed pipeline located in the area of the intermediate package located in the exposure test shield. The test, to be conducted to 480 psi, will be gas-tight and will be fitted with two small access ports. May Cooper will be able to fire the gun by means of a single switch on an instrument panel. Purpose of the experiment, which is similar to the one conducted by the Bureau of Aeronautics (NACA, Mar. 28, p. 25), is to determine the characteristics of a fire under varying conditions. A number of angular positions can be used in these fire tests. The Bureau will indicate a pressure of 400 psi.

**Flashing light sphere.** A 5-in-dia. sphere containing high-intensity light and batteries, will be mounted in the cockpit. Once in orbit, it will be activated at an angle of about 92 deg from the right path of the capsule and downward. Because of its brilliant nature, it is expected to help avoid the possibility of a collision with another satellite. The sphere will also indicate the orbital velocity with a series of distinct 44.9-second pulses. During these orbits, light will be programmed to flash every second, and Cooper will attempt to photograph it with a hand-held 16-mm movie camera. He also will estimate distances between his capsule and the flashing sphere for later correlation.

with the movie film.

Atmospheric drag. In a report of an experiment flown aboard MA7, a 50-cm-dia. Mylar-coated sphere will be moved behind the orbiting Mercury spacecraft on the end of a 100-ft. long maneuvering boom to measure atmospheric drag at three altitudes. Primary purpose of this balloon experiment will be to determine the feasibility of the altimeter-

I orange sphere (the sphere in *I* was undecolorized) is considered a secondary isopentene. Manned's Custer program affects all the *I* and *II* isopentenes and also creates a connection between the groups, which links the *II* to the *MA-7* capsule, and the *II* to the *MA-9* capsule. During recently completed Custer's *MA-7* capsule review the *MA-9* balloon has been right to provide gas storage, used to be the reason the *MA-9* is failed to expand properly.

There will be one hemispherical region and some minor changes in representation. In the hemispherical ex-  
-eriment, Chapiro—who is expected to  
-work between 12 and 14 hr in spe-  
-cific tasks periodically uses a special  
-technique. I hope to work with him to examine

After flying, using a combination of map, compass, the self-reliance and transfixion techniques and a small plastic bottle, the time of sunup and sunset noted on the bottle.

longer islets. Center program can, however, deal with the long data flight times of Gemini and Apollo. I like to make maximum use of the time aboard a spacecraft and want to use the electronic-ether in a way, as stimulated by possible water-cue

ed as a coolant fluid for the cabin proper was shut down the cabin cooling system completely for short

of time during his flight at the station within the cabin should be acceptable level. But cockpit is not however, will require continuous monitoring of the environment, which has been in all previous Mirspace flights, will be placed by an end user. The end monitor will be attached to one of the surfaces made of fabric which will be hung in it that it may be out of the way when not in use. When not in use to measure the body temperature, the thermometer

will be used to monitor self-inspection. The test cylinder is located in the helmet. The pilot will wear the same type of motion detection patches on his body as decoding Mercury pilots. In addition, a switch will be placed on the

A project was to be passed on the development of a compact access hatch. High-priority radiation data would be obtained with that gathered by the energy level anisotropies of the detector mounted on the MARS. Radiation attenuation through the Mercury capsule structure was unknown. It is not believed severe, but center project personnel know to some extent.

Upper will carry only one passenger in each alongside his coach on orbital Mercury missions but in two seats, one on either side of pilot's cockpit.

He hoped that Cooper will be able to sleep during his long duration flight. Astronomists specialists here would be on duty to see Cooper's eight-hour sleep divided. Sleep period patients

### **Review Couch Developed for MA-9**

Benton, Tex-New rules that mark major changes in the laws and regulations surrounding much of radio activity in the forthcoming National Radio Act of 1934 were outlined by Leslie Casper.

The new couch consists of quasi-woven nylon strands about 1/16 in. in dia. which expand under high loading and as the process shows deextensi<sup>on</sup>, the big extensi<sup>on</sup> deformation and return to original dimensions of no elastic material. The strands expand roughly 50% and do not contract to original lengths when loads are removed. Although some load is given off, it is not a heat modulus which causes extension of the strands.

Strands in the canopy are differentially preloaded to accommodate the relative mass of the plant body, nowhere resting on that surface. Tense surfaces, for example, bear higher load through strength of the hand arm. Pre-loads are calculated to accommodate the plant's weight and the g forces of branch flight. The strands position slightly as the plant body continues, but do not deform to their maximum limit under these premonic fig loads.

SI Monday, however, sales both opened up the pilot approach 16 to 12g, and strength is exceeded and the sykes given. Because the strength held, especially those strength given less than others and so the pilot's body only exercises in situations. Nylons stands no use by Saxon, like, of London, R. I.

If the crowd is used on MA 9, Mr. Cooper also will a new refined horses, quickly developed for the 1974 program. The horses a little with like up each and immediately return at the pilot, under no entry loads, and deeper into his horses. There is no return on the ends so that the pilot remains held tightly against the couch.



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### Rocket Cluster Firing

Challenge studies of low payload, solid-propellant rocket motor, pressurized and at 10,000 lb. of thrust, was recently test-fired successfully by United Technologies Center, a division of United Avocet Corp. (AW 18, p. 37).

Planned for the flight is break-up into two low-thrust periods. Optimum re-ingress of work load, either this oxidant-pushing load, would be 8 to 10 hr. of duty, 4 hr. sleep or re-entries, 8 to 10 hr. duty, and then four days of sleep or rest. Final 6 to 10 hr. remaining as the flight would be quiet work and on-duty.

Provisions are being made to analyze the pilot's performance. Through a time interval, from the time of the initial ascent, it would be recommended to whenever ground tracking stations have the unique radio range at the time.

Present planning calls for letting the sleeping pilot sit his first-duty capsule pass through orbit transition without re-entering the spacecraft to a return-firing attitude in order to conserve attitude control fuel. During the orbit flight at Wurtsmith's MAF capsule, the spacecraft was re-entered to re-enter attitude at the end of each orbit and in the event of an emergency would be terminated the flight at that point.

Breaking up the sleep period into two almost equal segments would provide more useful data, it is felt, than that which can be gathered during one eight-hour stretch. First sleep period would include data points which the reliability of the second sleep period could be compared and evaluated.

Not all on-duty hours will be spent

in continuous work, there will be breaks where Cooper will be allowed to do as he chooses—take photographs, make star or cloud observations, etc.

Studies of Cooper's metabolism, respiration and blood pressure readings will be extremely important to biostatistics research. Data on three cycles—three legs, platinum and palladium—will make a major contribution to the detailed design of future life-support system. It is anticipated that oxygen consumption will be measured initially with Cooper breathing normally, but then breathing and not under low rates will vary with work requirements.

Several other experiments are planned on the MAF capsule itself. There will be at least one—and perhaps two—white patches of cyclic coating (not a paint) applied to an approximately 8- or 9-in.-square area on the capsule after deployment of the capsule.

Thermometers attached to the inside of the structure behind the patch will indicate variations in heat transfer through the coating during ascent, orbit, flight and reentry.

In addition to two of the three body straps will be attached to a high-altitude flight for demonstration of non-aerosolized oxygen wear during orbital flight. These straps will be exchanged after the flight and recovery of the capsule for detection of micro-oxidized straps.

Experiments in this area will be able to demonstrate how many non-aerosolized straps and flight patches can be exchanged during ascent or reentry.

Two pounds of breathing oxygen will be needed to the MAF capsule. A 5-lb. capacity, liquid oxygen storage tank will be added to the MAF capsule during the first three flights (AW Oct. 18, 25), but will contain only 10% of hydrogen peroxide. Two 3,000-watt electrical heaters will replace the two 1,000-watt electrical power supplies used on earlier Mercury flights.

Nine pounds of water will be added to the spacecraft cooling system and five pounds of water to the pilot's drinking water supply. Lithium hydroxide breath-hydration scrubber has been removed from 4.5 lb. to 3.6 lb. Food will be dehydrated and consumed with water before eating. Liquid, such as orange juice and juice, will be prepared and reconstituted by the addition of water.

As on previous Mercury orbital flights, Cooper will attempt to make sightings of stars plotted on the ground. Perth, Australia, and Durban, South Africa, have been used on orbital flights, but cloud cover proved so extensive that the National Aeronautics and Space Administration is considering several other areas. Cooper will carry a photographic camera for astrophotography to measure star intensities.

Speed of the capsule type reentry,

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and to store pilot communications when the spacecraft is beyond range of a ground station, will be cut in half, from 15 in., six to 11 in. in size, to match the capability of the type receiver available increasing trac length. At its present speed, the scanner has an 11 in. capability.

Reducing the speed by half increases this to 12 in.

Slow scan television systems will be used to reduce the weight, size and cost of the television equipment, and bring the polar bear. The television camera will have an angle lens adapter so that it can be rotated to look out the polar's window.

Copper will earn a 35-mm movie camera, built by McDonnell Aircraft Corp., which also manufactures the Mariner and Gemini spacecraft, or 16-mm in the hand held 35-mm camera and for extravehicular photography in color Mariner flights.

The 16-mm camera will be mounted as a removable, self contained module in the instrument panel.

Installed in the panel, the camera will be rotated, tilted and adjusted to various angles. It can be removed and placed on the instrument panel or left on a table over the capsule window to film the performance of the dog balloon.

Camer speed can be set by the pilot

either at six frames per second or a single frame per second.

Camer, with three rapidly interchangeable lenses—wide-angle, telephoto and normal—will be equipped with an image intensifier, each with 300 ft. of life.

One of these pads will contain a film file. Copper will shoot this roll for the Massachusetts Institute of Techology, an agency of the Congress, by using a hot wire detector of the earth's horizon in view from space.

This data is considered vital to the Apollo guidance system, which MIT is developing.

## Lockheed Develops 'Radiation Yardstick'

"Radiation yardstick"—which will provide engineers with a definitive guide for designing structures and for dividing nuclear reactors—has been developed by scientists at Lockheed Missiles and Space Co.

The device measures the fast neutron absorption cross section on gold, which is used as a standard reference in determining the absorption characteristics of other materials. The coated part exhibits a spherical shell of thin gold



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2 in. in diameter, which contains a radioactive source material.

Shell is heat-treated with alpha particles from a Van de Graaf accelerator, all the reactions they produce effusively dissolved to the gold as gold is passed through the shell.

The precise determination of the reactions is performed by the nuclear source and that created in the gold is the absolute measure it is an indicator of the neutron absorption characteristics of the gold.

Principle of the technique was to develop a standard for neutron absorption in the energy range from 10,000 to 400,000 electron volts, which has been a source of disagreement among nuclear scientists.

### Cameras to Monitor Entries of Meteors

Washington—Sodernation, photographic柯达 in racing auto. Meteorite data will go into operation soon to monitor meteor entries and to locate meteors after they have fallen on the earth.

The project, called the Project Nickel, is managed by the Smithsonian Astrophysical Observatory under a \$740,000 grant from the National Aeronautics and Space Administration.

Object of the photo program is to photograph bright meteors as they enter the earth's atmosphere, and to locate the fragmentation of the parent parent, which may last.

When the system is fully operational it will automatically photograph the sky in all directions four hours to look for meteors.

Photographing system will sense darkness at each station and activate the electric power to operate cameras. An electronic timer will send out pulses, the North Star.

If the star is obscured by cloud over the station will then draw.

Each station will have four cameras with 16.5 lenses covering 80 deg. view field.

Observations will study the chemical and mineral structures of recovered meteorites. Photo plate data will provide new information on brightness, velocities and orbital elements of meteors.

Photo plates used in the Project Nickel photo program will be 9 in. square. The plates will be negative films of up to 2 in.

Field Supervisor Charles Tonge will have his headquarters in Latrobe, N.Y. Station will be located in Elmont, N.Y., Maha and Rellis, N.Y., Vinton and Carroll, Iowa, St. Stanislaus, Maha, Alina and Nels, N.Y., Endicott and Bingham, S. D., Mauston, Cedar City and Pleasanton, Kan., and Woodward and Huron, Okla.

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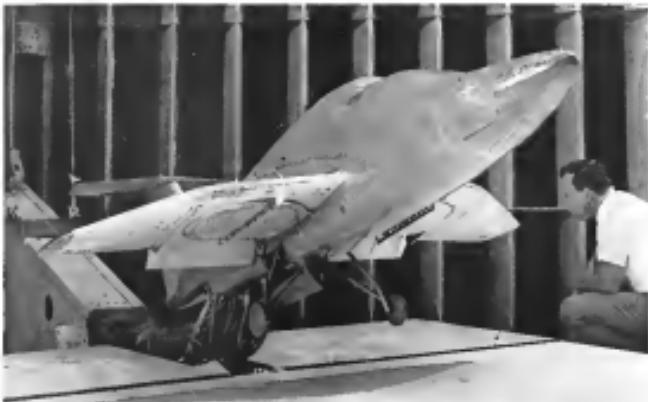
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ONE-SIXTH SCALE MODEL of XV-5A, with dynamically similar fan in ducts during tests in wind tunnel. Wind tunnel open fan ducts show vertical motion through lift fans. Landing gear is deployed. Turntable is shown.

## Flight Tests of XV-5A Scheduled to Start



ONE-SIXTH SCALE MODEL of the 1/6th scale flight research vehicle installed for testing in the pressure of simulated ground in General Dynamics/Curtiss low speed wind tunnel. Angle of attack is fixed attitude typical of conventional landing. Wing flaps are deflected, full down.

## AERONAUTICAL ENGINEERING



MODEL OF XV-5A forward fuselage and engine nacelle section, held by turntable, was tested at angles of attack and yaw over a speed range down from 600 miles per hour. Tests were made in the Curtiss wind tunnel and Navy's David Taylor Model Basin.

## This Summer

By David A. Anderson

San Diego—Structural design of the XV-5A lift fan flight research vehicle is scheduled to be completed at the end of this month by Ryan Aeromarine Co. engineers.

First of the two VTOL aircraft now under construction here is expected to start its flight test program July 17.

Before the aircraft is flight tested, however, it will be subjected to a tight schedule with these milestones marked as goals:

- Feb. 1: Completion of five-degree camber flight simulation
- Mar. 1: Completion of all engineering systems design in shop, first fuselage out of the jigs
- Mar. 30: Completion of 10-degree lowering simulation

• Apr. 4: Start of aircraft static test

• May 8: Completion of hydrostatic

• June 1: Completion of wind tunnel simulation

Structural work is scheduled to be delivered to NASA's Langley Research Center and Air Force's Research and Materials Center for full-scale tests in the 40 x 80-ft. wind tunnel starting early in July and extending through mid-August.

First hovering flight of the first aircraft is expected to be made Aug. 11.

Currently, all model wind-tunnel testing is essentially complete with the exception of flutter work, which is



XV-5A THREE-VIEW shows overall geometry of the Ryan-designed and -built six-tenths scale aircraft. Ryan is subcontractor to General Electric.



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Overall per 10-30' sec. I	0.1 cps to 10 <sup>7</sup> sec	0.1 sec to 10 <sup>7</sup> sec	0.1 sec to 10 <sup>7</sup> sec	0.1 sec to 10 <sup>7</sup> sec
PRICE, F.O.B. FACTORY WITH INLINE READOUT (option HI)	\$2,500	\$2,300	\$2,750	\$2,800

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The Model 727B provides 30% greater frequency range of prices directly competitive with vacuum tube units.

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Overall per 10-30' sec. I	0.1 sec to 10 <sup>7</sup> sec	0.1 sec to 10 <sup>7</sup> sec	0.1 sec to 10 <sup>7</sup> sec	0.1 sec to 10 <sup>7</sup> sec
PRICE, F.O.B. FACTORY WITH INLINE READOUT (option HI)	\$1,995	\$1,875	\$2,000	\$2,150

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Model 726B

The 726B provides a 5 mc frequency coverage at 1 mc price.

Model	0.001 to 5 Mc Frequency Time Interval	0.1 sec to 5 Mc Frequency Period	0.001 to 5 Mc Frequency Counted Model	0.1 sec to 5 Mc Frequency Model
Overall per 10-30' sec. I	0.1 sec to 10 <sup>7</sup> sec	0.1 sec to 10 <sup>7</sup> sec	0.1 sec to 10 <sup>7</sup> sec	0.1 sec to 10 <sup>7</sup> sec
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The Model 729 Frequency meter consists of an all solid state 13 mc frequency switchable meter and a vacuum tube heterodyne converter. Model 728B extends the digital range to 2000 cps. Model 727B extends the digital range to 1000 cps. Model 726B covers the 1000 to 500 cps range and Model 725B covers the 200 to 1000 cps range.

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Price: Model 729C (less digital) \$2,150, with digital readout \$2,375. Pricing: Model 728B, \$2750. Model 727B, \$2000. Model 726B, \$475. Model 725B, \$550.

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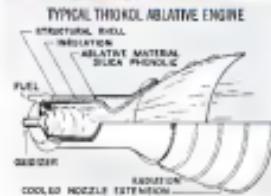
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Rocket Operations Center, Ogden, Utah  
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one could not meet the simple weight requirement. Thus far studies of an IIR new volume committee show the development time span would not be substantially longer than that required for a simple review and that the other process costs of the requirements could be met best in this way.

But the fixed dimensions of the GE X-33's powerplants on one hand, and the restrictions of the Army regime limits on the other, imposed strict limits on the design compromises that are usually the prerogative of the designers themselves. Some examples of these include the following:

- Side-by-side seating specified by Army meant that the maximum fuselage width would be at the cockpit, rather than in the engine section near the center of the fuselage. Result is that the fuselage is shaped somewhat like a pencil in top view.

- Annex packaging of the original fissile arrangement was built around a belly mounted Isolator in the driver, as what was in a nose above or negative would become a problem. Rata had discussed this problem during an earlier study for USAE, and decided to invert the Annex package to solve the re-arrange problem by avoiding it.

- Characteristics of the *Whale* writers that most affect and rather than expand on addition to the fans and reboots. These stories tend to be kept short to keep the weight and losses down. Stories that are longer than 1000 words are kept to a minimum of 500 words. Fan stories are killed if the cover feedback should be kill, dash, or conflict with those facts and values, and that these stories would have to prove the fanfiction sides and the engine scenes endings as well. This ruled out a conventional story message, shell characters, and multiple endings. Fanfiction stories are designed to be a simple, single frame with a fan-like space for the stories. 35

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## Manufacturers



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**Allison**  
THE AMERICAN DIVISION OF  
GENERAL MOTORS, INDIANAPOLIS 60

diagonal of the wing, influenced the bending moment of wings. Particularly poor angle designs iterate if the air plane deflected in one way or another from the size and shape of those two wings.

XV-5's 500-lb fan is rated at 7,450 lb of lift thrust or 2,550 lb of horizontal thrust, depending on the operating condition. Static weight is 1,345 lb, which corresponds to a thrust-to-weight ratio of about 4.4 for VTOL flight.

Heart of the aircraft is a General Electric 1054GE-5 gas generator, mounted in either landscape or controls. Immediately downstream of the gas generator section is a flow-on valve, which forms a T in the flow line. The diverter can be operated to allow the discharge of the gas generator to bleed straight through and not acting as a simple jet engine, or to turn through 90 deg, move a bleed air vent, and direct through bypass. The wing stage has two large downstream, independent fans (AW Aug 5, 1963, p. 94).

One way to visualize the XV-5's powerplant is to think of a stack of valves. The top valve is an assembly of inlet louvers in a large diffuser to direct the air into the engine fan. The second valve is the fan assembly and the turbine scroll. Third valve is the static duct, the fan after and the turbine section assembled on the rear frame. Bottom of the stack is another valve assembly to direct the air leaving the fan.

In VTOL operation, all the air passing through the fan is directed upward to produce vertical thrust. For takeoff, the inlet louvers are gradually tilted to deflect the air off to produce forward thrust. When the aircraft is moving fast enough to be supported on wing lift, the diverter valve is moved to give off air through the jet engine nozzle for forward thrust and the fan valve and vents are closed.

Supersonic airflow, held in the fan is about 200 ft/s. Total of GE's fan ducts is about 10 ft. At 10 ft/s, about 20 ft of the supersonic flow is consumed and spreads out suddenly, slowing ten times to the surface of the earth. One engineer described it as being under a tree in front of a falling anvil on a very slow, fast-flowing brook.

From engine start to full-speed operation of the jet generator takes between 10 and 15 sec. The fan develops 160% lift above three to four seconds after the dynamic valve is raised to feed the fan.

Turbine Mach number at takeoff conditions of 2,600 ft per sec is in the range of Mach 0.60 to 0.65. The fan handles about 515 lb of air per second. Installation in the XV-5A cells for a pair of these fans resulted with



**COCKPIT OF XV-5A** cockpit shows combination of conventional and helicopter control stations. Pilot has front-left seat, with the right seat as a MILBIS instrument position sponsored by aerospace institution.

entirely dry engine-air ducting for supersonic airflow. In the event of a single-engine failure, the remaining engine in the carrier continues to divide its gas bypassing ports between the two fans through the crossover ducting. Because of the portability of the fans and their characteristics of operation, each fan has a power output about 60% of its design lift, although being driven with only half its design power. This means that 80% lift is available in emergency situations, and the XV-5A will be able to land out of a VTOL approach on a single engine if it is lightly loaded.

All external part of the fan installation in the XV-5A is the nose gear fairing, by a pair of sheet leading from the nose gas generator supply. It normally produces about 900 lb of lift, but its weight and costs can be apportioned and controlled to produce any value from about 200 lb to design thrust to about 200 lb of noseweight.

Some concern for the wing design was that it had to accept the fan, and be the most efficient wing possible so as to obtain the highest possible wing loading. Wind-tunnel tests showed an optimum distance between the leading edge of a wing containing a fan, and the centerline of the fan bellows. It was this test that determined the mid-edge location of the XV-5A wing.

From drag tests it was found that effective area of the wing was producing about 10 deg of downwash angle and had to move the tail in the top of the aircraft in order to get it out of the circulation and save some weight.

The chord of the wing was determined by consideration of the stiff tail and that plus the remaining available space on the wing, need the entire aircraft.

Another of the anomalies of the aircraft showed there would be a need for an degrees of negative deflection to eliminate the lead moment of roll due to yaw. Wind-tunnel tests of wing alone and body alone showed that the analysis was right, but the combination



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### SIZE 11 TEMPERATURE-COMPENSATED TACHOMETER ELECTRICAL CHARACTERISTICS

INPUT VOLTAGE (V)	115
INPUT POWER (W)	3.5
INPUT IMPEDANCE (KOHMS)	1500
INPUT CURRENT (A)	0.277
OUTPUT IMPEDANCE (OHMS)	5000
OUTPUT VOLTAGE (V/1000RPM)	3.76
MAX. NULL RMS (VOLTS)	0.030
LINEARITY (%)	0.07
SIGNAL TO NOISE	140
PHASE SHIFT AT 20°C (DEG.)	$\pm 0.5^\circ$
SCALE FACTOR VAR. W/TEMP.	$\pm 0.4\%$ $\pm 0.5\%$
PHASE SHIFT VAR. W/TEMP.	$\pm 0.5^\circ$ $\pm 0.5^\circ$

proven that two plus two doesn't always make four, especially in a word period.

The combination actually had completely different characteristics from those inferred by acoustic wing and body tests, and finally required four degrees of positive deflection of the outer panels out to get proper lateral stability.

Obviously, the GE 360° was used to the top of the wing to control the roll after. NASA's initial tests showed the loads to be unacceptable with this layout, so they were changed to the latter, down now used on the XV-14.

Wheelbarrow landing gear of the XV-14 is the conventional truss type, with the strut and fair struts, of gas for emergency blowdown. Struts which are used in two positions, forward for nose-down takeoff and landing, and moved off a few inches for the VTOL use. The nose gear deploys in the fairing.

When the landing gear was in the retracted position for conventional takeoff and landing, it was repositioned in the cohort of the fair during VTOL operation. Interactions between strut and fair caused a deflection of left that was substantial. The final belief was it was decided that the wheel had to be made into a two-position gear to get it out of the cohort during VTOL operation. Interactions showed that the nose in weight was 40 lb. But the increase in lift obtained in the nosewheel fairing was 150 lb.

### Thrust Spikes

Farthing between the engine blowdowns is a pair of thrust spikes which will be used as a research and measurement tool to operational aspects of the future. This allows engine operation at full open, while the aircraft is flying at reduced speeds, a technique that is similar to the use of drag chutes during the approach of conventional aircraft.

Arrangement of the cockpit crew is standard for flight test, but on a more unusual basis, the Ryan engineers are the last to get in and off the aircraft. They sit at the left of a two-position seat during a standard act of cockpit controls. A switch with a radio, gyro, altitude pedal and commander throttles. Both sit in an angled around base. At his left there is also a 50° seat like the collective stick in helicopter, with the usual bending float control mounted on the left stick. The console-mounted throttles are slanted to the right wing throttle.

Controls are connected individually to the airplane surface controls and to the flight control system. By operating individually or collectively on the levers, they direct the flow to produce roll, pitch and yaw during landing.



ONE-EIGHTH scale model of the XV-14 is shown being mounted in wind tunnel for section for load testing.

Right. For conventional flight, the controls work in the standard way, with roll, ailerons, elevators and elevators pedaling, ailerons in yaw, roll and pitch, respectively.

Strand Iran controls are provided for moving the aircraft about all three axes either in forward flight or VTOL operation.

Stably augmented system has been designed and built for the XV-14 in order to meet the stability requirements for stability and control during VTOL flight.

When the XV-14 first flew, it was believed in a long series of wind-tunnel tests of generalized and specific models of both the aircraft and the flight system covering a range of scales from one-eighth to full size.

Test series began in June, 1968, with

the first run of a single Merlin under static conditions on an auxiliary test at General Dynamics' Research Center. A year later, a full scale aircraft model was funded, built and tested by National Aeronautics and Space Administration's Ames Research Center as part of its general study of VTOL aircraft.

A second lift fan was built as a high-speed version and tested at GE in jet-disk of a more sophisticated system than was obtainable from the first static runs of the base fan. This fan was delivered to NASA at Ames and built by the center into a second full-scale model with one fan in each wing.

Total time spent on both these NASA models exceeded 250 hr., with the longest amount of time devoted to the first of these NASA models in environmental conditions.

Cloudy full-scale model approach to the real airplane was made initially by NASA. The agency built and tested a full-scale model closely resembling the first XV-14 configuration. These final model tests will be succeeded by tests made on one of the two XV-14 aircraft. Before either flies, one of them will be through a series of wind tunnel tests at Ames Research Center in the 60 x 120 ft. tunnel, where the previous tests were studied in detail.

NASA's Langley Research Center will contribute to the program with the design construction and testing of an 18% (about one-eighth size) free-flight dynamic model.

This will be tested in a smaller tunnel and lights developed by the center to determine nature of the full-scale airplane flight characteristics. Tests will include both vertical and lateral modes of operation.

### Ryan Models

Ryan's major effort is wind tunnel tests that have with a series of three scale models which have currently logged more than 600 hr. of research time. The three models are:

• One-eighth scale, for conventional flight and/or flight. This model was tested first in the General Dynamics Convair low-speed tunnel, and then up to Mach 0.9 in tests at the NASA's David Taylor Model Basin. One result of these tests was the winning of the low-speed tail fin from an originally proposed position low on the vertical tail to a new high position on top of the vertical tail.

• One-eighth scale, for power and lift-off tests. This model has dynamically similar power features in both wings and the nose. Tests were made initially at the Convair low-speed tunnel, and ensured the speed range from base to maximum converses velocity. Checks of ground effect were made over an altitude range between base and the first dimension of the ground. Tests were run at various angles of attack and yaw, and the pitchup operation was also checked.

• One-half scale, for engine rudder optimization. This model consists of only the forward portion of the fuselage and engine nacelle. It was tested over a wide range of yaw and pitch angles at low speed, and over a less-extreme range at high speed. All tests were in the David Taylor Model Basin tunnel.

Final evaluation is currently being conducted on a series of model tests being run by Ryan. To reduce the number of runs needed and keep the high cost of tunnel testing to a minimum, Ryan made extensive test runs on completed Rotta models using the components attached to the company's flight simulation laboratory. This preliminary work, conducted in an enormous amount of test testing, is intended from us to generate

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## VERSATILITY

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The unit above is an ultrasonic AP transducer by Trans-Sonics, Inc. It runs at 100000 Hz, produces a 0.5 volt output over a distance of 0.59 mm.

It is a straightforward and versatile device.

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Transducers and systems for the measurement of level, temperature, pressure, and flow—represent the versatility of the mission-oriented engineering talent at Trans-Sonics, Inc. (Illustration: Photo of Leni Deneke, TM)

To put the case in perspective—

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and near the projected center of the transposed waves. Controls on the rear-panel switcher set for the pilot and pilot plane are for observer and altitude collective for left control, stick for pitch and roll, rudder for yaw, and throttle for forward speed control. Modification to the transducer will have the device used in conjunction with the transducer, as recommended for the 7A (AW Ant. 25, p. 531).

Pilot sees horizon distance indicator or distance to the ground at 6000 ft. Transistor timer down-lead off the aircraft, measuring the time of apparent pass under the nose of the aircraft to indicate forward movement. The horizon appears as a shadow line between the sky and horizon, trans and indicates aircraft attitude readily.

### Simulator Section

Rotation of the simulator is enhanced by the 720-deg angle of view, which permits a 360-deg display in pilot's peripheral vision. More vision is provided by using the other side of various stretchers located on the ground after passing by them. Pilot and observer using the simulator actually have experienced varying and various sensations although the cockpit remains stationary.

Forward light source projector, manufactured by the de Flores Co., Inc., Eaglewood Cliffs, N.J., was purchased from complete with three different transparencies. These are designed so that the following XV-14 simulator can be used.

- **Transition.** Forward light from laser after takeoff. Maneuvering area is 1 sq mi and altitude from 0-600 ft.

- **Hover after takeoff.** Area enclosed is only 1,000 sq ft, and altitude ranges from 0-160 ft.

- **Conversion Flight.** Presentation is done in 40 sq m area and altitude ranges from 0-75,000 ft.

Projector unit weighs about 2,000 lb and is driven by an electric motor. Using ultraviolet projection, six different frequencies (one red, one blue) transparent along all three axes. The beam from the forward light source, a mercury vapor lamp, is reduced to 0.05 m, of size and diverges to give a vertical arc of 300°. Lenses converge all the light in 15-30 foot candles along the optical axis of the collected beam.

Forward light source mechanism which is free to move in one direction, will divide the 1,000 to 1 (scale-model) stretchers glued to the transparency of the pilot floor into three. The light source is projected from moving past the edge of the 60-sq. boundary of the transparency when a limit switch contacts the boundary walls and halts its movement.

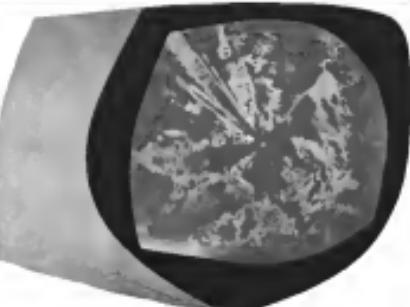
Right side of the simulator at a

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**DCP-10 DIGITAL DATA PROCESSORS** are high speed general purpose computers designed for signal processing applications. A sleek, compact structure houses the DDP-10, faster than comparable medium-size computers. Memory cycle time, 5 nanoseconds. A single add operation takes 10 nanoseconds. Fetch and program control and data transfer are 10 nanoseconds. Input/Output character and word buffer, parallel transfer, asynchronous full interrupt.



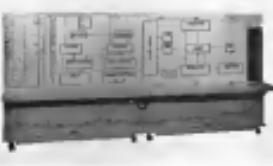
**REAL TIME COORDINATE CONVERSION COMPUTER** continually processes two eighty-five foot parabolic reflector antenna beams from either satellite and space probe vehicles from a West Coast site. The antenna, computer and a massive data link form the closed loop tracking system. Computer Control has also developed a Coordinate Conversion Computer, now in use as part of the system. This real time tracking system is designed to photograph missiles during reentry.



**DELAY LINE TIME COMPRESSION (DLTC)** equipment are in test. One is about subminiature, the other extends to about 10 feet. Both provide real time compression of signals to facilitate reentry. DLTC equipment digitize input signals and feed them in real time to a digital signal processor. The processor compresses them in time for real time signal operations. **3C** DLTC equipment provides significant reduction in the complexity and size of signal processing equipment for applications to sonar, radar, telemetry and radio spectrum analysis.



**SPACE DATA AUTOMATION SYSTEMS** are solid state systems designed to make possible receipt of telemetric data from unanned space vehicles, selection of signals to be processed, and various experiments and data on command messages sent to the spacecraft. The **3C** SDAS allows unanned spacecraft to vary their command sequences by internally programmed sequences or by externally generated sequences. External signals, sensed by experiments, or by receiver commands, SDAS systems operate on less than 1 watt of power.



**DIGITAL COMPUTER SIMULATORS AND LOGIC TRAINERS** are employed in teaching basic concepts the fundamentals of digital computer operation, programming, and operation. These units consist of a general purpose computer in a separate cabinet, connected to a logic trainer in a front panel. The trainee selects an entire class to form his own individual logic demonstrator. Various types of logic modules with logic ICs, standard symbols are plugged into the front panel for logic interconnection by the instructor or student. Computer Control has also developed a variety of digital training systems for industry and the military.

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- Digital logic and computer training devices
- Computer language translation
- Information storage and retrieval
- Pulse pattern and range time code generation
- Digital processing systems
- Computer test and simulation
- Space vehicle instrumentation and simulation

In just 10 years, 3C accomplished many firsts in digital systems. Examples will include: first computerized and first computerized training system; first computerized test and simulation system; first all computer design for telephone repeater.



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**X-15 Window**

closed-loop type, which enables the pilot to move hardware to be evaluated, designate distance from program, and implement program. The program is internally generated and can be used for the simulator aircraft as many as 150 amplifiers if needed. But 130 of these amplifiers are reserved for other aerospace projects. Company engineers estimate, however, that for other simulator applications, such as launch handling and rendezvous, all 310 amplifiers might be used.

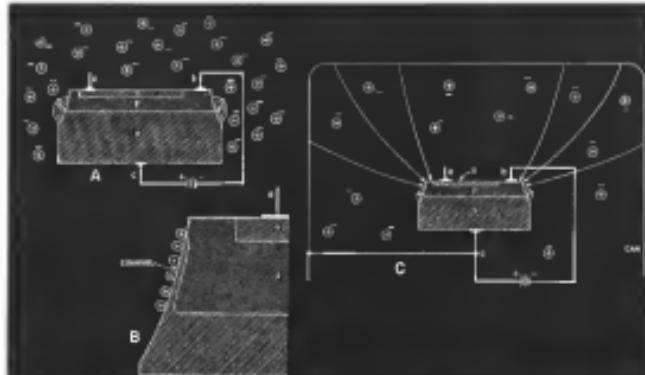
The simulator is installed in a 6,000-sq.-ft. building, known as the Room Flight Simulation Laboratory. The building is designed with large access doors to permit entry of test aircraft, which can be hoisted into the loop with the pilot sitting in the cockpit of the aircraft, or mounted on a flight carriage. The building also houses the analog and recording equipment, a hydraulic distribution and a hydraulics laboratory.

Other applications of the simulator include plans to use it for certain phases of the Vought-Hiller-Ryan V/STOL XG-142, now in the flying-transport development program (AV Jan 14, p. 60). Results of the XG-142 simulation work will be due next March. Vought's simulation

At least one large aircraft manufacturer on the West Coast also plans to use the simulator, according to Baier.

First three windows for X-15 research aircraft have been flown. The first window, 19 in. x 30 in., and 12 in. block will be mounted off the cockpit or the bottom of the ship. The base lead from the thermocouples around the edge of the glass to the outer surface for contact to leads of monitoring instruments. The instruments will record heat distributions across the panel during flight of the X-15. Windows for the research aircraft will be manufactured by Glass Glaz, Wurzburg.

## AVIONICS



**RECENTLY DISCOVERED DEGRADATION** of transistors in space radiation due to surface effects is believed to result from ionization of air ions in transistor base which produces positive ions and electrons (A). When reverse bias is applied to transistor, it produces electric field between base and collector which attracts ions and builds up channel that allows gaseous ionized carrier current to flow (B). This effect is enhanced by electric field which exists between crystal and its metal can in shown in (C).

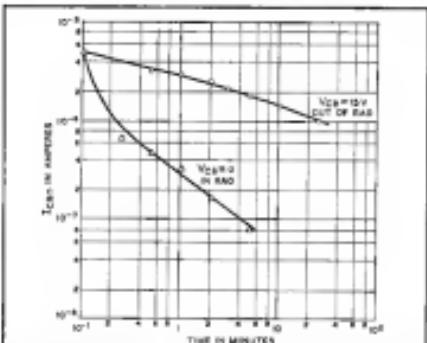
## Transistors Face New Radiation Hazard

By Philip J. Klass

Important new data on enhanced degradation of transistors produced by radiation which contact the metal blanket of the Transistor 1 microsatellite satellite and which can explain the early deaths of many microsatellite transistors has been obtained by Bell Telephone Laboratories researchers. The information has important implications for all engineers designing spacecraft avionics equipment.

While it has long been known that high-energy radiation particles could cause static-potential effects in semiconductor devices, only recently has it been discovered that an entirely different type of degradation results from contact of an ion or gas surface a transistor or diode base when exposed to radiation in microsatellites, low Earth orbit. The discovery is credited to G. L. Miller of Bell Telephone National Laboratories and Walter M. Gibson of AT&T, during a nuclear-physics experiment.

Silicon transistors used in digital circuits, such as those for command and telemetry functions in spacecraft, are more vulnerable to the ionization in-



**FORTUITOUS CHARACTERISTIC** of nuclear-effect radiation damage is that recovery occurs quite rapidly in the continued presence of radiation if the reverse bias voltage is removed. This fact made it possible to convert Transistor 1 satellite microsatellite by disconnecting its electric power.



## Colossus,

This is an research bearing game for a 3D&2D-artist who wants to practice. It contains ten levels with many obstacles.

Philadelphia Gens out and hardened this germinating grass to within 15 feet around. Even many existing timber areas on soil or ground grass, etc. remain at Philadelphia Gens.

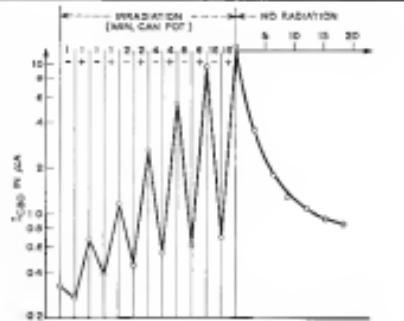
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**POTENTIAL WHICH NORMALLY** exists between insulators can and could have an accelerative or voltage insulation degradation depending upon its polarity, Bell Telephone Laboratories test show. Results shows insulators that positive potential aggregates damage, but other tests show of reverse effect.

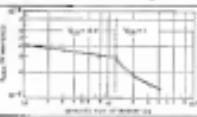
face-effect radiation damage than the same densities and in lower (radio) counts, according to the results of a BNL investigation, partially sponsored by USAF's Aerospace Systems Division. Results of the investigation are reported in the January issue of "The Bell System Technical Journal" in an article jointly authored by D. S. Perle, R. R. Blum, W. E. Branson and T. M. Smith.

Estimated susceptibilities of man and of digital circuits might explain the early demise of Avco's Courier 1B communication satellite, launched Oct. 4, 1963. The satellite carried quadrupole transmitters and receivers to assume long life but after a few weeks in orbit it failed in the non-redundant command system, made it impossible to activate the satellite's payload.

Some of the significant findings that emerged from the RTL investigation on surface-effect degradation due to subnormal use are:

\* Degradation shows itself as an increase in the collector reverse current of a transistor. Silicon transistors normally have very low collector reverse current compared with germanium devices and thus appear to be considerably more susceptible to radiation damage.

- Reverse electrical bus as a transitor, particularly, when logic, quickly increases its vulnerability to overcurrent damage, a situation which exists for devices used in digital circuit. Susceptibility appears to increase as the square (harmonic power) of the bus voltage. But the conduction of harmonics results in



**RECOVERY** of transistor performance occurs when heat is removed from radiation exposure, but recovery is greatly accelerated if the reverse bias voltage is removed, as shown in these plots.



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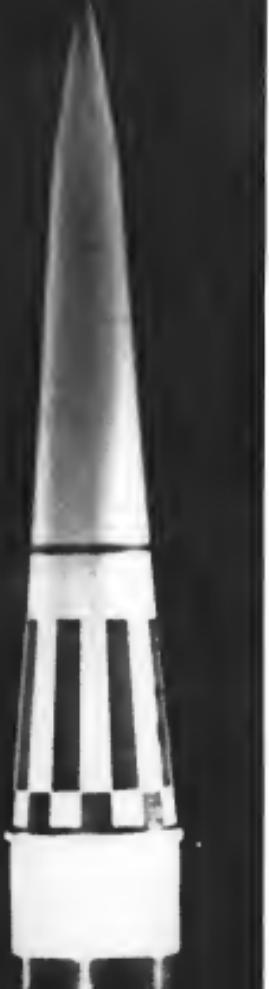
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**SOLID PROPELLANT WEAPONS.** Pershing—fast accelerating system, built to fire almost instantly under rugged field conditions. Fastest test record of any missile—37

complete successes in 64 launches. Bullpup—the nation's only supersonic air-to-surface missile, so reliable it is handled like a round of ammunition without pre-flight checkout. Lacrosse—with pinpoint accuracy. All three on duty with Army, Navy, or Air Force.

**HARDWARE ACTIVATION.** Responsible for hardbasing Titan I and II—history's most difficult construction test. Completed an schedule for Titan I. Progressing on schedule for Titan II.

**RE-ENTRY BODY DEVELOPMENT.** Specifically, Pershing—altitude range code which withstands rapid acceleration, deceleration and high re-entry loads.

**NUCLEAR POWER SYSTEMS.** SNAP generators for test sites, and space systems—world's first in space, test audience, first lighthouse, first weather station. Portable reactors at Sundance, Wyoming, and South Pole.

**AIR DEFENSE AND COMMUNICATIONS.** Missile Master and BIRDIE electronic air defense systems operational in 29 major metropolitan areas. JACCP communications system, providing direct dialing, telephone-type service for 700 simultaneous conversations on a single frequency channel, without wires or central switchboard. Missile command and control systems, ASW systems.

**MATERIAL DEVELOPMENT.** exotic materials, with high heat flux, high strength with low weight. First production technique for fusion welding of high strength aluminum alloy. Isotopic fuel forms, tubular fuel elements. Semiconductor materials research, microelectronic elements, cryogenics, ceramic heat shields, plastics, surface, molybdenum honeycomb.

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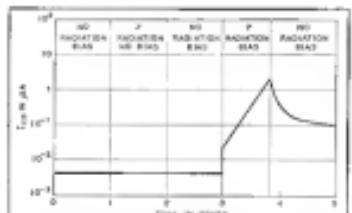
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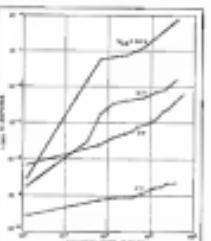


**IMPACT EFFECT DEGRADATION** (left) shows only when both radiation and reverse bias are applied, to results of tests on a different silicon diode than those in the main figure. Device shows partial recovery of original performance. Dose rate was 150,000 rad per hour. Tests on two types of silicon diodes (right) show that early dose tests are less vulnerable to surface-effect radiation damage, but that later saturation damage does occur at higher dose rates.

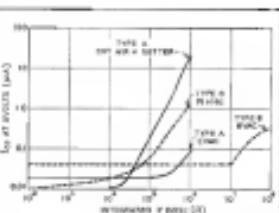
similar earlier discovered radiation damage to rectifying structures, is not yet obtainable. Instead, instead of the unannealed diode, closer to the radiation, or removal of the bias voltage results in at least partial recovery of its original characteristics.

But a most startling finding is that occurs later place later when reverse bias is removed and the transistor is still exposed to the radiation which produced the initial damage. This was demonstrated in a test using two identical transistors whose collector-to-emitter current when exposed to radiation and operation with 15° reverse bias had been reduced to 1% of its original value. In this test, one of the two transistors was left in the radiation field with no bias voltage while the other removed bias but was removed from the radiation.

Reverse current of the transistor still exposed to radiation but without any bias voltage dropped to 0% in memory, in four minutes, while the other



**TRANSISTOR** degradation in the form of increased reverse current due to radiation produced surface effects increases with the magnitude of collector bias voltage.



**TYPE A** (left) and **TYPE B** (right) are two types of silicon diodes that early dose tests are less vulnerable to surface-effect radiation damage, but that later saturation damage does occur at higher dose rates.

While increased shielding may provide some protection, what can efforts by device manufacturers do to operate transistors at lower reverse bias levels, if higher-dose radiation must be used by semiconductor manufacturers?

But this makes semiconductor crystal surface phenomena which, in contrast to bulk semiconductor effects, "are very poorly understood and in general even poorly characterized," according to BNL scientists. "Surface effects on semiconductor devices have as close to no history of stability and permanence," they add.

Previously, lattice bulk radiation effects were considered to be the dominant damage mechanism, involving atomic and surface effects, of two types: • hole-electron pair generation, involving the semiconductor crystal lattice, causing ionization as a result of collision between radiation particles and bound electrons. This effect, while it can change crystal conductivity by many orders of magnitude, is a transient one, with the greatest part remaining when radiation is removed.

• Crystal lattice damage resulting from collision of energetic particles with nuclei in the crystal lattice, is a permanent and slowly reversible effect. Damage occurs only when the radiation particle loses sufficient energy to the atom it strikes to move it from its original position in the lattice. This means that the amount of damage depends upon the type of radiation, with energetic protons causing far more damage than energetic electrons.

Theoretical analysis, supplemented by extensive tests, to determine the basic cause of the severely damaged surface effects, indicate that it is not from radiation striking an or passing through the transistor and breaking it down into ions and electrons. Such radiation can be produced by an type of radiation particle.

Electric field produced between the

# 30th Inventory of Aerospace Power Issue

## March 11, 1963

Never before have aerospace industry developments played such a dominant role in the shaping of world affairs. Countless milestones have witnessed with excitement: the manned orbital flights...the pioneering achievements in global communications via Telstar...the initial exploration of the planets by satellites like Mariner II...progress on the revolutionary supersonic transports...and official acknowledgement of the Apollo lunar landing program as America's goal.

Clear understanding of these events by engineering, scientific, government and industry planners is vital to the economic welfare of our industry. As we have for the past 29 years, AVIATION WEEK & SPACE TECHNOLOGY will tackle this challenging editorial task in our March 11, 1963 INVENTORY OF AEROSPACE POWER issue.

The largest full-time editorial staff in aerospace publishing—thirty-four graduate engineers and aerospace specialists—will reveal the short and long range significance of hundreds of international technical and market developments. Included will be charts, graphs, tables and other editorial information covering all aspects of industry programs. Budgets, plans and programs as missiles, aircraft, space vehicles, support equipment, engineering, space technology and civil air transport developments will be featured.

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**Symcom Antenna**

This photo shows an transportable, 30-ft-dia tracking antenna built by Douglas Aircraft Corp. for use in NASA's Surveyor communications satellite program as well as with Defense Dept. communications satellites. Antennas can transmit and receive signals from satellites, according to the manufacturer, according to Goddard. Portable device is mounted on a pedestal about 12 ft high, has a 1000-lb weight and a 14-ft span.

collimator and base of a reverse-biased transistor crystal separates the negative electrons from the positive ions, carrying the electrons to impact on the collector side of an NPN transistor, while the positive ions are attracted to the steeply doped surface of the base. On both regions, these charges tend to produce reverse bias. For example, the positive ions induce an electron-rich inversion layer, or channel, on the base which in effect extends the collector region out over the base. (See block, p. 15.) This causes the collector-to-emitter current and the thermal current to the emitter, and it is this current carried to the collector, it is assumed, that is emitted by a cathode.

Besides the collector or input transmission is electrically connected to the transistor base, when reverse bias is applied it produces a field within the crystal which creates positive ions to move toward the surface of the transistor base, which increases ion collection efficiency.

Currently, the use of RTL technology in the development of a transistor which has been developed, but there are enough discrepancies and unexplained effects to show the problem is not fully resolved. For instance:

- Performance degradation appears to depend more on total dose than dose rate, but under some conditions the dose rate may be the determining factor.
- Polarity of transistor can, with respect to transistor base region, appears to be a significant factor affecting degradation.

in some tests but not in others. In tests using an protonium transistor, degradation occurred when the can had a positive potential with respect to the test place when the can had a negative potential. But in other tests, this often was reversed. Thus there is no clear-cut evidence whether the positive ion or the electrons produced by radiation ionization is the dominant factor in surface effects or whether both play important roles.

- Electron generation transients in the device under test, especially a relatively small transient in reverse bias, can cause about 4-5, until the dose reached about one million rad, where dose rate, increases increased. Dose dose exhibited no change change with dose rate tested 10 million rad, while an older group stated sharply at 10,000 rad, indicating that ionizing-radiation damage growth, albeit somewhat, the effect of reverse bias voltage also was less than for the silicon transistors.

On the basis of a limited number of different types of transistors and diodes, RTL scientists conclude that there is wide variation in their vulnerability to ionization degradation, even between apparently identical devices. This suggests that their individual dependences upon processing techniques used in manufacture and there can be considerable variation between individual batches.

Despite these troubles resulting from the ultra-high radiation environments produced by RDT&E, RTL scientists continue to work on the problem and have developed particularly techniques to reduce effects that can be ameliorated using high high level doses of radiation. The results of these brief tests can be correlated with data obtained from subsequent low-level, long-time exposure tests.



**Millimeter Wave Laser**

Millimeter wave laser operates at signal frequency of 95 GHz, (10.4 cm) with peak power frequency of 100 W, (0.01 J), using 100% gas with 50% noble gases, according to Westinghouse Electric, which developed it for USAMRMC Electronic Technology Laboratory. Major was an integrated beamline system used to test 4 DK.



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Note the distribution of transconductance values in actual test and the fact that this distribution is not as tightly clustered within the tolerance band as the total value indicated on the chart.

This chart compares the distribution of test data with the distribution of the total value of Nuvistors selected in 1962. Transistor limits, as typical of the performance you can expect from all transistors—published by RCA—indicate the range values of individual transistors.

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TRANSCONDUCTANCE (MHz)	TEST DISTRIBUTION		TOTAL DISTRIBUTION
	MIN.	MAX.	
RC4-700A 13.000	11.000	15	1.000
RC4-700B 30.000	25.000	315	1.000
RC4-700F 1.000	445	44	1.000
RC4-100A 1.000	4.500	34	1.000
RC4-100B 24.000	11.000	315	1.000

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\*\* including the gold grid contacts = 50

Recently, after you've opportunity to design to your own needs, you can now do it. Test distribution of these Nuvistors—over size and light weight, is especially remarkable. In addition, with the unique feature rugged construction, extremely low interelectrode resistance, high accuracy and stability, and the fact that they are in the class of active elements used in the most exacting applications in communications, future from such a remarkable product.

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## BUSINESS FLYING

### Business Aircraft Manufacturers' Reports Indicate Sales Increases

Interest of 134% in commercial aircraft sales was recorded by Cessna Aircraft Co., Wichita, Kan., during the first year ended Sept. 30, 1962. Cessna delivered 3,344 aircrafts, as 46% of the total units sold by the company's aircraft division, and 39% of the division's delivered units, comprise aircrafts.

Commercial units in the company were 588,300,000, representing a 20% overall increase over last year, with after tax earnings of \$1,861,000 or \$1.41 per share, compared with earnings of \$1,127,000 or \$1.35 per share in fiscal 1961. The decline was in aircraft leases. Commercial units total 1,300 units of business aircraft delivered during 1962.

Two significant aircraft are under way to service the company's sales volume. The company will manufacture single-engine aircraft at its Greeley, Colorado, and has formed a European branch with headquarters at Geneva International Airport, Switzerland. The latter is to be managed by Dan C. Cessna, who previously owned com-

pany product exposure in the aircraft market through increased availability of demonstrators, aircraft, accessories and parts for European Cessna dealers. Options will be known as Cessna Air Craft Co., Mexico Branch.

In related reports from business aircraft manufacturers:

• Piper Aircraft Corp. reports sales of \$75.1 million and earnings of nearly \$1.5 million for the fiscal year ended Sept. 30. Previous fiscal year sales were \$57.6 million with earnings of \$845,429. Sharp increase in earnings is attributed to delivery of high startup aircraft during 1962 at the Vero Beach, Florida, plant.

• Beech Aircraft Corp., Wichita, Kan., reported an earnings of \$425,000 in total sales for the first quarter of its 1963 fiscal year, compared with the same period last year. Indications are that the company's sales in fiscal 1963 will rise in \$50-75 million compared with last year's \$67.6 million. First quarter 1963 earnings after taxes were \$74,161 at 25 cents a share.

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## Why this Fairchild device...



## ...is wearing a new hat.

At Northwestern University, researchers are finding out how to make football helmets safer. To aid them, Northwestern players wore a special helmet in eight games last year. Within its lining are six Fairchild Micrologic units—complex electronic circuits in a package the size of a pencil eraser—part of a system to measure the direction and intensity of impact. The equipment frequently registered impacts as high as 300 G's—300 times the force of

gravity. To a football player, that's a lot of impact—but it's nothing new to a Fairchild device. Built to withstand factory tests as high as 200,000 G's, they're used to rough games.

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## Turbine-Powered, 10-Place Bell 204B Enters Commercial Helicopter Market

Bell 204B, four-seat pressurized 10-place version of the Army's Iroquois, left right, will enter the commercial market with Federal Aviation Agency certification, which is expected in mid-February. First customer will be delivered to Shibusawa and Co., Bell's Japanese Distributor (AW, Aug. 6, p. 75). Two others have been ordered by Japanese. Large cabin and longer tail boom distinguishes the 204B from the 204A version, which it will replace. Both have been developed by Bell Helicopter, Inc., Dallas. Cabins below right seat sixteen, forward or rear of rear. Floor and rear floor front to rear. Three other Bell models to 204B have either received or are receiving similar status. Model 472 is a redesigned 204A, except for a new interior. As a result, Bell has been able to lower the price \$20,000. Cabins for the 472-24-1 and the 472-36-1, right, have been reduced to 16, to 40 in. and fuel capacity has been increased from 45 gal. to 60 gal. Bell says the fuel economy will have range in 400. Price has been increased \$1,000 on each model. The turbocharged 104-1 also will have high weight blades with 18 ft added to each blade tip. Increased collective control and a 100 lb. gross weight increase to 3,900 lbs.



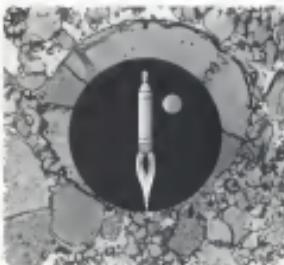
## where 'white glove' inspection begins with inspection of the white gloves...

Ex-Cell-O maintains an atmosphere of dedication to quality control in the strictest sense of the phrase. Ex-Cell-O's clean room facilities are modern and complete. Here, skilled technicians, tools, work surfaces and processing materials are kept clinically clean in environmentally-controlled Class A, B and C rooms. ■ Engineered especially for contract projects for aerospace, atomic, electronics and allied industries, Ex-Cell-O clean rooms accommodate gaging, inspection, assembly and packaging of precision parts and assemblies in prototype and production quantities. Included are facilities for testing of servomechanisms, actuators, control rod drives and other assemblies. ■ Ask your Ex-Cell-O Representative for details, or write direct for a prompt, professional response to your requirements.

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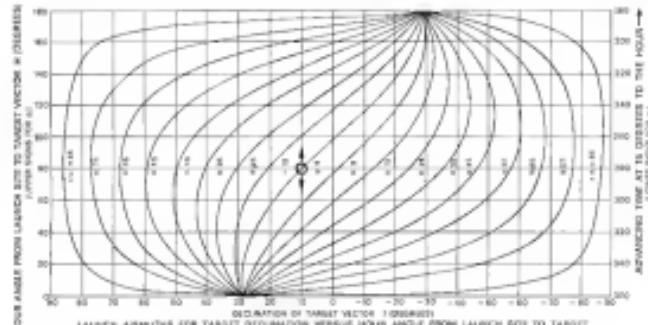
Elkonite materials have solved problems in hot gas valves, semiconductor bases, and many other space applications. Their versatile properties may hold the answer to a materials problem you have encountered. Let us see if we can be of assistance. Write to Mallory Metalurgical Company, P. O. Box 1882, Indianapolis 6, Indiana.



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# LUNAR LAUNCH · JULY 17, 1968



How do you launch into a geosynchronous planar trajectory from Cape Canaveral to a specified target vector? This family of curves demonstrates the interrelationship of the target vector declination, equatorial hour angle and launch azimuth. They can be used to estimate the launch requirements of lunar probes. For example, suppose a lunar vehicle launch is scheduled for July 17, 1968. At this time the declination of the moon will be +92° (NASA Technical Note D-501). Assuming an hour angle of 80°, the launch azimuth can be found to be +5°. The azimuth change for  $\pm 1$  ft. launch window  $1 \pm 15^\circ$  in H will be  $\pm -2^\circ$  to  $\pm 12^\circ$  as can be determined by moving along the  $4 \pm 10^\circ$  line.

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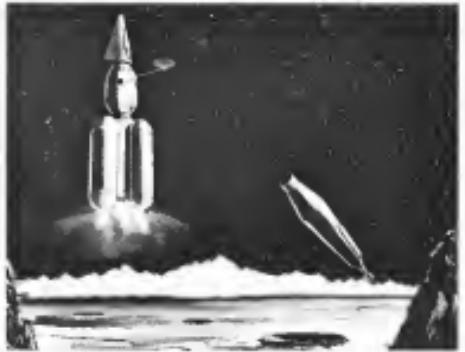
You will find details of current positions on the next page. Your reply which will be held in complete confidence, can be made on the attached Professional Placement Inquiry form or by writing Mr. R. M. Smith, Chief of Professional Placement and Personnel, Mail Zone 130-90, General Dynamics/Astronautics, 5720 Kearny Villa Rd., San Diego 12, California.



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**LUNAR LANDING** The spacecraft commanded by General Dynamics' Astronautics is shown landing down onto the lunar surface, controlled by powerful retro-rockets, after its journey from the earth. The discarded second-stage fuel tank is shown at right. Large tanks, attached at base of the capsule and crew shell on entry glider vehicle, provide fuel for landing on the moon and take-off power for return to earth. The tanks also provide a measure of protection against space radiation for the crew. Reactors are arranged at slight angles to the craft to avoid problems in landing which might be caused by "digging" holes in the surface of the moon.



## DYNAMICS ENGINEERING

\$5 or less in engineering, physics or math with two to four years of experience and familiarity with the application of existing real digital computer techniques for operating in the following areas:

**STABILITY AND CONTROL**, to conduct theoretical studies on the overall dynamics of large space boosters and space vehicles. To determine stability and transient response of space boosters in a given environment, to analyze the effect of various factors and environmental variables on the stability and transient response characteristics. 30 or 40 hours per month with analysis and synthesis techniques for probabilistic and nonlinear control system parameters. Background in aerospace dynamics is required. 10 working control system environments and general dynamics by means of space boosters.

**STRUCTURAL DYNAMICS**, to determine response of an elastic system to an impulse or transient load. To conduct theoretical studies on the dynamics of space vehicles. 30 or 40 hours per month with analysis and synthesis based on an impact load for evaluation of responses and systems. 10 and for measuring units of complex systems. 10 hours per month with analysis and synthesis of complex systems. 10 hours per month with analysis and synthesis of complex vibration isolation requirements. 10 working factors, etc.

## AEROTHERMODYNAMICS ENGINEERING

\$8 or \$10 or \$12 or \$15 to develop design criteria and perform methods development in the area of aerothermodynamics. Partner considerations are reentry heating, heat dissipation in free space, and reentry heat sources. Should have two years of experience.

## FLIGHT MECHANICS

Advanced technical problem engineer at all levels required for studies of new Flight Dynamics Development Series Programs. Partner considerations are reentry heating and reentry against atmospheric and atmospheric. Responsibilities of the Section also involve technical analysis and simulation work in support of all space vehicle programs at Astronautics.

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Position calls for the following three areas for specialists who are familiar with computer techniques, possess a degree in engineering, physics or mathematics, and have at least two years of appropriate experience:

1. Development of guidance equations and techniques necessary to perform basic satellite rendezvous, to determine the best trajectory to particular orbits. Will investigate techniques, derive and implement techniques, and define the proper role of man in these maneuvers. Astronautics also involves the development of techniques for satellite optimum trajectories for reentry maneuvers using the methods of dynamic programming. 10 hours per month with analysis and synthesis of problems plus the incorporation of approximate techniques into the development of guidance equations.

2. Investigation and organization of characteristics of heat and reentry environments. Will conduct general studies of reentry requirements, including windows of entry, entry velocity, angles and trajectory characteristics of the target body. Will also do a technique to satisfy powered reentry requirements.

3. Development of techniques for determining the best estimate of the reentry trajectory and the best estimate of the reentry environment for a given set of constraints within the means of a spaceflight computer using numerical filtering.

## OPERATIONS AND SYSTEMS ANALYSIS

Position involves the study and development of advanced building and operating techniques that both enhance the efficiency and reliability requirements. Responsibilities include advanced conceptual planning, design and system evaluation. Advanced degree preferred. Three years of appropriate experience required.

## ADVANCED SYSTEMS HEIGHTS ENGINEERING

\$5 as engineer with four years of experience in solving and component weight allocations and controls. Will work with programs and data to determine weight and design weight and height requirements.

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If the inquiry card has been removed, or if you wish to have or request more detailed information, please write to Mr. R. M. Smith, Chief of Professional Placement and Personnel, Mid-Zone 120-10 General Dynamics Astronautics, 5779 Keele Park Avenue, San Diego 12, California.

## MANAGEMENT

# Khrushchev Hits Soviet Industry Planning

Moscow — Soviet Premier Nikita Khrushchev has reportedly agreed with the views of Antoni P. G. K. Antoni, the Soviet's chief administrator in Russian industrial planning. He said the reorganization of technical lead roles in the defense sector is an example for the rest of Soviet industry to follow.

Nevertheless, a recent Khrushchev speech to the Communist Party's 20th National Congress indicates he is not yet willing to let all of Antoni's controversial projects into practice—or those of five congress-appointed Soviet economists.

Antoni, in a series of articles published in the official *Pravda* newspaper, accepted Antoni's lead and called for a more efficient management of Soviet industrial enterprises (EW, July 23 p. 71). He concluded that existing industrial practices and management methods were not suitable for the development of modern enterprises.

On Nov. 16, the day before Khrushchev's speech to the Communist Party's Central Committee, *Pravda* published another Antoni article on concepts of shortening in Soviet industry. In Antoni's opinion, the shortening of the lead role in which the executive director of an industrial plant is responsible for production—was not what one should expect from Antoni.

Antoni, critical of those (including, possibly, himself) who had "gone astray" by seeking an ideal version of bureaucrat as the solution to Russia's industrial planning problem, "More and more enterprises are not in any aspect of the problem, and not the executive at that," the Russian economic designer said in his latest *Pravda* article.

Antoni also spoke to Antoni, Antoni who also spoke to the USSR's Supreme Soviet last month.

The Soviet leader has urged that a characteristic feature of almost all production units regarding new planning methods is the effort to find a solution to the problem with within the plant. This work is a certain stage for planning and design work where the managing work which would originally consist of all the efforts of a plant's personnel is given to the plant.

This two-sided approach reflects the characteristic of economy to integrate the planning and design problems which characterize the use of Comin model construction.

"Of course an increase in capital construction, greater labor productivity, and all the other things planned in

the action of planning reform usher in my own judgment, is necessary."

But critics—the owners of private enterprises, those who are only interested in making maximum profits—blamed the reorganization of technical lead roles in the defense sector as an example for the rest of Soviet industry to follow.

"Our position is something quite different. We are building enterprises and managing as we want ourselves to be managed in the light of our own interests," Antoni said in his speech to the 22nd Communist Party Congress.

Antoni, in his earlier *Pravda* article, charged that Soviet industry has management and labor have failed and that methods of measuring output are unreliable. As a result he declared, Soviet industrial plants would change "from bad to worse" and achieve better coordination, much directed from the top, in the right way to eliminate waste and duplication and achieve faster technical progress.

In calling for abandonment of conventional solutions that only concern great output and not the useful value of pro-

## Bell System Tests

Bell-France test tower and test and test activities under way with the Bell-France telephone industry leading system for marking the first European contract for Bell-France.

Test program to be carried out at French long distance telephone test center near Paris will begin next March and will last one year. Contract in long distance telephone by French military and civil budget source has been submitted in the test station. Test program reportedly will cost \$125,000.

French will use a Marconi Series 1000/2500 Plessey telephone system. The French hope to begin a test of the system in a telephone exchange in Paris. The system will include one of the Gantel and a Gantel II in a later stage.

Bell system is part of an overall French program aimed at experimenting with various automatic landing systems. Besides the Bell and the Sodalis systems, French civil telephone also intend to test the Bell AL, Plessey AS-211 system and the French-developed CRF AS-211 system on Bell's Gantel.

Sed Antoni is on his own, also plans to install the Bell's mobile telephone and multiple routes on a production Gantel for test purposes.

Antoni gave this example: "A factory makes aircraft engines which can operate 1,500 hr before complete destruction. At the same time it is known that the members required to make an engine with a longer life of 1,800 hr would cost not twice as much, but only 20% more, which is absurd."

"It is no, despite the obvious advantages of making a better quality product, so [Soviet] enterprises cannot and no aircraft engine factory will do this on its own initiative. Cross output, you see, would fall in the case 20%."

Khushchev's speech was not the only one in which much must be done to improve existing planning. He expanded some simple with unprofitable reforms which would bring about capitalistic economic organization. But he concluded that better coordination, much directed from the top, is the right way to eliminate waste and duplication and achieve faster technical progress.

The Soviet general supported Antoni's contention that certain plants, in order to fulfill existing production tasks, are forced to exceed norms and standards, including those of the Bell-France system.

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Antoni's production is measured in tons of weight, it is logically easier that quality of current output and the cost of production per ton differ correspondingly. The higher the grade of current output the higher the weight in its production.

On this, the output of plants which



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**Contact Mr. G. J. Herres, Personnel Office, Atomics International, 5500 Delta Avenue, Canoga Park, Calif.**

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product reinforced concrete elements such production is assumed to take more time and labor. In addition, note the fact that these elements differ and require different amounts of fiber for their manufacture.

Similarly, the output of rolled steel is assumed to take. The index for measuring production is the same, that the labor consumed in rolling heavy sections or light sections, cold-rolled sheets or pipe, is entirely different. Each of these rolled articles requires a different outlay of labor and money.

However it is clear, Khrushchev can boast that more quantity of rolled steel is being produced at present in both types of article production. He did not give a clear-cut indication of a plant's operation. It often happens that a factory which has fulfilled the plan in time by stopping the equipment for less labor consumption but higher article gets a bonus.

But another factory engaged in the manufacture of more labor consuming but lighter articles is disposed of at a bonus if it has fulfilled slightly short of the plan as measured in time.

It is evidently necessary to arrange suitable expressions of success plans in different industries in order to develop incentives for increasing output, increasing production activity, which will more correctly characterize the operation of enterprises.

Khrushchev also discussed the role of profit as an index of a plant's qualitative performance.

Some economists overlook the fact that profit, as applied to the socialist economy, has two aspects. If we take our socialist system of economy as a whole, profit as an economic category does not have the social meaning it has in capitalist society.

In socialist production, profit is the sum of all economic results and the main stimulus for its development. In the socialist economy system, the main aim is to satisfy the requirements of society. Our industry produces goods not to obtain profit but because the whole of society needs the goods.

The situation is, however, different if we take an individual enterprise. In such case the question of profit is of great importance as an economic index of its operating efficiency.

How a plant works at a loss or at a profit and whether it can earn the necessary amount of revenue is extremely important. Without profit, reconstruction is impossible to commence at that level an enterprise is operating and what establishment of it is leading to the general wealth of the people."

Khrushchev proposed a three-point plan on the shortcomings of Soviet cost accounting. He suggested:

■ Reducing the number of regional economic centers—which administer Russian industry at a geographic basis.



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from about 180 to around 40. "Our team of enlarged economic councils will help eliminate local except trend (productivity) and discipline efforts to obtain more material resources and funds for capital construction when the situation arises and determined to run all state interests."

• Following the Communist Party's rule in approving economic decisions, The central economic council would be divided into two parts, one of which would be specifically charged with "leading" and "guiding" industry, checking on its management and preventing more basic industry interference. The other parts would deal exclusively with agriculture.

• Imposing workers to greater effort is, according to workers' unions committees which would consult with management on matters of production, planning and control.

• Khrushchev's three main "reforms" with greater autonomy appear to bring competition. For lesser bureaucracies looking over the shoulders of management and scientific and technical personnel and for greater individual initiative, autonomy and broader decisions making powers for R&D managers.

The Soviet presser also said nothing about the need for relative supply and demand relationships in the Soviet economy, something which Antonov argued at a recent meeting.

#### Meetoffs: Organization

In discussing the need for faster technical progress, Khrushchev argued for the creation of more centralized management organizations.

"First of all, it is necessary to reorganize the management of scientific research and design organizations and to do this with the bulk of resources in this work. We must introduce extensive specialization of production and stop the growth of all-purpose factories."

"The President of the Communist Party's Central Committee has discussed these questions and arrived at the unanimous opinion that the leadership given to management and design organizations should be centralized in the appropriate industrial committees that will hold up in a vertical line. Only thus can we be sure of following a single, unified technical policy."

The fact that this step is perfectly parallel at the present time is not by the way of excessive accumulation in the committee of economic leaders in branches of the defense industry. "Only then can we be sure of following a single, unified technical policy."

"We don't see any alternative to the experience-based management and centrally planned. We should remember the words of Lenin, who said he had to learn 4,000 tons, from the experience and adopt everything of them that is sensible and suitable." Khrushchev concluded.

the most modern weapon," he told the committee.

Obviously it is necessary to be guided by the same principle in other branches of industry, too. The leading design bureaus of plants as well as scientific research and design organizations having experimental facilities should be directly subordinated to the industrial committee," the Russian presser said.

Khrushchev noted that capitalist industry "still has room under its competition," makes extensive use of specialized and centralized design and research organizations.

#### Capitalists: Competition

In other capitals, the introduction of new techniques in production is stimulated by competition. In order to avoid bankruptcy, capitalist firms introduce all kinds of new features.

The capitalists are aware that with output falling, it is necessary to stand out in competition with firms that are using more modern equipment. If the capitalist set in this way, then new socialist planning criteria can make such a successful use of its advantages to step up the technical progress of production, to increase output, and to improve its quality."

At present, Khrushchev argued, the efforts of some collectives of engineers, designers and workers are divided and clash with one another, thus sharply reducing their efficiency in protecting the national economy.

It is difficult to assess that there is no question of all of cutting out existing competition among designers for the heading of the best works of machines as long as there is centralized guidance of design work. On the contrary, broad opportunities must be created for the manifestation of creative ideas and initiative.

#### Slow Application

Cases of scientific and engineering achievements being given a long time after they can be used to bring shortcomings in the produce of scientific and technological nation in the national economy.

"Centralization of design work brings the capitalist high profits. The example, in the United States industrial, design work and 80% of all production are concentrated in three leading concerns—General Motors, Ford and Chrysler. This is economically beneficial."

"We don't see any alternative to the experience-based management and centrally planned. We should remember the words of Lenin, who said he had to learn 4,000 tons, from the experience and adopt everything of them that is sensible and suitable." Khrushchev concluded.

## GD/FW Engineering Dept. Reorganizes

Fr. Worth—Engineering department of General Dynamics' Fr. Worth has been reorganized into three groups: Research and Engineering, F-111 Engineering, and B-58 Engineering. In the wake of the award of the F-111 (TAC) contract, the group

Concern termed the reorganization the largest change in organization in the history of the organization.

Robert H. Walker, vice-president Research and Engineering, will oversee five departments and two centers under the new structure. These are headed by J. E. Coyle, director of systems tech; E. B. Madsen, director of aerospace technology; H. R. Dow, director of nuclear research and development; R. E. Adams, director of all-source programs; R. H. Schwartz, director of materials and technical services; and N. D. Roberson, manager of special projects.

F-111 Chief Engineer W. G. Duda has eight major sections in his department headed by E. E. Dick, project engineer; Guidance Aircraft Controller; R. W. Miller, manager of F-111 tests; C. A. Stange, manager of arm and propulsion systems; M. F. Haney, manager of avionics systems; E. H. White, manager of airframe design; M. E. Allard, manager of physics and controls; E. D. Martin, manager of support requirements; and G. C. Somers, manager of systems analysis.

B-58 Chief Engineer B. R. Kirk will have six major sections, headed by W. G. Muller, manager of arm and propulsion systems; C. R. Cowart, manager of avionics systems; W. N. Shulman, manager of airframe design; D. L. Breyfels, chief of physics and controls; R. T. Scott, chief of test programs; and J. R. Mason, chief service engineering.

## Lack of Maintenance, Parts Cited by GAO

Washington—Department of Army and Navy overhaul and training units in the U.S. and overseas have been "less than efficient" by lack of maintenance and replacement parts due to insufficient internal funding, according to a report to Congress by the General Accounting Office.

The report is directed at the Army and Navy policy of allocating "surplus funds" to combat units for the maintenance of equipment and supplies. From 1967 such funds increased. The sum intended to cut waste.

The Army-Navy review of allocating excess funds for the purchase of parts—such as allocating the aircraft parts—in being re-used by DOD

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# Republic Seeking Diversification To Backstop Phaseout of F-105

New York—Republic Aviation Corp. made preliminary studies of over 300 companies since 1968 for merger or acquisition in its diversification efforts, and has recently studied and discussed the possibilities with 20 of them, according to Republic President Marvin J. Patai.

Of the 300 companies, more detailed studies were made of 30 of these firms, but was further reduced to 10.

Project lines ranged from aerospace components, electronic equipment and computers to farm implements, building construction and hydraulic pumps. Annual sales volume ranged from \$300,000 to \$100 million.

The question of diversification, Patai told the New York Senate of Senate Analysts, often is raised in connection with Republic's future after the F-105 fighter-bomber is phased out of production.

Recent contracts call for production to continue through the end of October, he said. Republic's present backlog of \$380 million includes \$400 million in F-105 business.

Subcontracts for the jet fuselage section of the McDonnell F-4C family, totaling \$132 million to date, comprise a large share of the remainder. These subcontracts are set aside 1964.

Propects for further F-105 business depend largely on the success of the F-105A. Republic is interested in the supersonic aircraft, but has no firm contract.

They also depend on timing of negotiations for delivery of aircraft and on the capability for delivery of the F-105 to meet the F-105A. Republic is building the F-105A in a version designated the F-105F, but future orders might be either for F-105Ds or F-105E. Production cost of the F-105 is approximately \$100,000 less than the F-105A.

Republic is interested in diversification that will give it other sources of the future. Patai said, but not to diversify away from the sole role of diversification alone.

A few of the 25 companies still under study, Patai said, but others have been dropped for a variety of reasons, among them, too much financial risk, too many disclosures, labor relations etc.

By reducing the use of diversification for its own sake, Patai said, Republic has lost one of its strengths in some money. Its current dollars have greater purchasing power than a series of dollars at various places which would add up to the same options, or like glasses a few years back. These dollars have more influence and Republic can use them to better advantage."

Republic has spent \$18 million in research and development, including \$83 million for a space research center since 1952 to broaden its aerospace and aircraft technology effort.

For the year 1968, said Republic, total sales were \$200 million, and net income \$10.6 million more than the year before, and rate of increase of its sales exceeded the industry average.

Plans elaborate on Republic's research and development commitment with the following specific cases:

• **Rock plasma engine.** Republic spent less than \$200 in 1967 for preliminary studies of a rock plasma engine for satellite control, and a year later spent \$470,000 to learn more about this area. At present, Republic has generated about \$2 million worth of contracts in this field, and spent \$1 million in research and development facilities and equipment to develop the knowledge it needed to set these.

• **Orbiting Solar Observatory.** Republic and its team members, including Massachusetts-Honeywell and Texas Instruments, are one of those chosen at a \$100,000 study contract for a second generation 1981. Bell Brothers and Space Technology Laboratories are the other study contractors. Including the proposed effort, Republic has spent \$400,000 on the study, but feels the effort will add to the potential of a potential \$100 million in business over the next 10 years.

• **Apollo.** Republic invested 25 years and \$750,000 in time and effort in an unsuccessful bid to build the Apollo lunar module. But the effort paid off indirectly in leading to Republic's current bid to build two new vehicles for Project Fire, which will teach Apollo crews, en masse, circumnavigation (AW Dec. 17 p. 55).

Based on present contracts, Republic expects to end 1968 in a position to be \$386 million total revenue for 1969 to 1970, or in much over \$500 million. Turnover this year is projected at approximately 24% of sales, and would total \$8 million compared with the paltry 1962 figure of \$1.9 million, or \$2.08 a share for 1962.

## Kill Radius Study

Kirton Nuclear, a division of Kansas Aircraft Corp., will conduct a six-month study to determine the kill radius of small nuclear warheads, possibly for use in Army's new Sprint anti-ICBM missile program under a contract to be awarded by the Army Materiel Command's Test Project Office.



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the electron collector headband and ionize molecules of the gas from the system. The positive ions are attracted to the negative ion collector producing a direct current. This current is directly proportional to the gas content. When signal is amplified and used to drive indicating switch it is a reading device.

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## Attitude Indicator Blamed in Comet Crash

In a lengthy team report on the accident in the British European Airways Concorde flight 001, the Turkish Ministry of Communications has blamed the attitude indicator (AI) in the aircraft's cockpit for the crash.

Following the report of the Turkish Aviation Investigation Team established by the order of the Ministry of Communications of the Turkish Republic (MDS) S/R/1116/1779 dated Dec. 21, 1984, the investigation committee at the request of the Turkish Ministry of Communications has decided to accept the Turkish Aviation Investigation Team's report. The team has done some evaluations for the report prepared by the Aviation Investigation Board of the Ministry of Transport and Communications and submitted through the British European Airways (BEA) dated June 8, 1982.

Under the terms of Annex 13 to the Convention on International Civil Aviation, the Chief Inspector of Aeroplanes in the United Kingdom sent Mr. H. K. Gadsden, B.Sc., a member of the committee to act as the U.K. representative to the meeting of the team in Atlanta, Georgia, on Dec. 10, accompanied by Mr. J. H. Lott, a senior investigator of the Air Accidents Investigation Branch and a number of representatives from British European Airways Corporation and the British Airline Pilots' Association. Mr. B. A. Moore, a senior investigating officer, joined the investigating team later.

Responsibility for investigation of the accident was delegated to the committee in the United Kingdom. The wreckage was examined at the accident site and three

parts which were required for ship-in laboratory examination were sent to London, then taken to the Royal Aircraft Establishment, Farnborough, England, April 19, 1985.

Aviation Registration Marking: G-AZPQ

Aircraft type, and makers serial number:

Concorde 001/001, Serial No. 0016

Certificate of Registration Number:

RAF 001/001, dated on Feb. 15, 1969

Category of Amenity:

Passenger

Number of Passengers:

100 (maximum)

Date of construction of aircraft:

1969

Name and address of registered owner:

British European Airways Corporation, London, United Kingdom, Middlesex, England

Cross weight moment generated in C of A: 7,656 Lbs (regulation aircraft weight 54,510 Lbs) at time of impact: 34,462 Lbs

Leading the position of the center of gravity of aircraft from the lead and tail center of gravity of aircraft: A. 1964, following a Concorde 1 inspection. Before the take-off on 001/001 the lead had complicated a total of 384 flight hours including 109 flight hours the same year of the current Concorde 1 inspection.

There were no signs of any defect or repair during the recent inspection of the aircraft which could be considered as being a factor in the accident.

Initial examination of all living control surfaces revealed no evidence of any damage or repair. The driving control is not present in the aircraft. There was no evidence of any present defect or failure apparent. The servoset units for power operation of the controls were in view for examination and the drives were being checked. There were found to be

no damage and normally. No evidence of defect or failure was found in the living control surfaces or to the servoset units and their respective control surfaces. The hydraulic system charge in tanks were set to the normal pressure. The drives for the servoset units were normal. The driving control was found to be normal and the electric gear change was on the servo position. No evidence of any defect was found in the electric gear drive spring shaft or solenoid valve units.

There was no evidence of any damage to the pitch units with respect to the take-off and landing directions indicating that these had been any leading of the control surfaces for maintenance, damage, or any other cause.

Examination of the rear flight leads showed no damage or damage and the evidence of damage to the flight leads had been completely destroyed by fire.

The flap set, set of 7.75 deg., i.e. take-off position, the three leads were broken and the leading gear was broken down.

No evidence was found of any electrical failure or damage.

The two hydraulic units were found to be normal and damage to the units had been to the leads and control cables to the units, which had been cut to the units.

Captains' drogue location: When the drogue was deployed, the aircraft was at the B.V.E. Firing position, it was found that the pitch unit "spider" was being elongated by the upper left drogue unit, which had elongated sufficiently for its head to be in the place of movement of the "spider". It is obvious that the drogue unit had been deployed before the pitch unit had been deployed. The lowered unit and its spring system were twisted, resulting in a further twist and a half turn. Examination of the three lead, the entries and the surfaces around the unit hole in the drogue unit showed that the unit had not been

tightened down fully during the assembly of the equipment. The appropriate seating surface contained none of the markings suggesting to be seen on a fully tightened assembly. Local disturbance of the point of the fitting caused that the assembly was tightened to a point where it left a mark from the fully tightened state.

Further examination of the equipment disclosed a pattern of rubbing marks on the right hand side of the pitch unit seating surface and these marks had been left by the drogue unit when it had been brought into contact with the end plate, by a drogue deployment introduced during assembly of the equipment.

The nature of the rubbing marks which showed three distinct groups indicated that the servo unit had been abnormal in its operation and the servo unit had been interrupted or disturbed from its place in the mounting fixture of the servo.

The righted marks are made before the servo had functioned sufficiently to maintain with the system.

No evidence was found of any electrical failure or damage.

The drogue unit was found to be normal and damage to the unit had been to the leads and control cables to the unit.

The drogue unit was made by the "spider" mechanism after the servo had been installed.

Close examination of the drogue unit

unit showed that complete obstruction to "spider" operation movement would have been occurred when the servo was not fully free from the restriction in motion. At this time the "spider" had not been able to move and the drogue unit had been deployed and, when the pitch position gear had a sufficient amount of travel available, then the aircraft had to follow 7.75 deg. pitch (the aircraft angle equivalent to the indicated position of the pitch position gear).

The drogue had been installed in the unit during construction of the latter and the drogue had been installed that the servo had not been

fitted and had been an option of any modification of it since Dec. 12, 1984 when the left control gear was changed.

The inspection results showed that the equipment had been assembled at all the assembly points of the equipment and the equipment was normal and clean by the means between there is a specific term "Check and MAIN WIRE" being used as service terms.

Engines and accessories: Four Rolls-Royce Avon 525 Mk. 116, 2,200 hr.

No. 1 Servo No. 36144 Running time -560 hr.

No. 1 Servo No. 36144 Running time -160 hr.

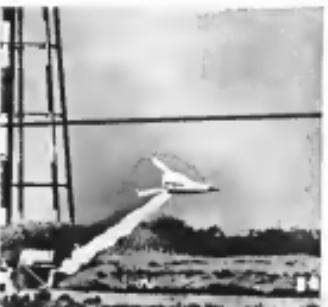
No. 2 Servo No. 36049 Running time -560 hr.

No. 2 Servo No. 36049 Running time -160 hr.

According to the records the engine had been maintained in accordance with the provisions of the maintenance Maintenance Schedule and the Certificate of Maintenance issued on Dec. 8, 1984 following a Concorde 1 inspection was issued in respect of the engine. There was no record of any defect or damage in respect of which could be considered to have had an bearing on the accident.

Dimensions of the power units showed that there were operating at a low power output of the number of output. The fixed servoset units were not in the full rated position and were not in the full rated position. The dimensions of the components of the drogue unit was consistent with the gear cases and bleed valves. There was no indication of preexisting mechanical failure. Both engine drives were in good condition and there was no evidence of any damage to the engine drives. The fuel tank selection valve was normal and all valvules under open, the pressure relief valve was normal and closed, and one drain tank closed.

The drogue unit had been installed in the unit during construction of the latter and the drogue had been installed that the servo had not been



High-Altitude Escape Capsule  
Tested on Edwards Rocket Sled



Prototype aircraft escape capsule developed by Lockheed California Co. for use at speeds above 2,000 mph and at altitudes in excess of 300,000 ft. It is shown during test at Edwards AFB. Unusually light, it is an instrumented escape reentry from rocket-powered sled. Test: Thrust: 2,400 lbs; capsule is shown in free flight, thus at its

altitudes a five-second-decimeter drogue procedure. In last picture, a T-20 aircraft drops the capsule to 27 mph for landing. Capsule reached a speed of 250 mph in this test; later it will be tested at 1,800 mph. In initial escape operation, the air tight capsule could land on water and float providing life support for the occupant until he was rescued. Lockheed has built five of the capsules, which in actual operation would be the entire nose and cockpit of the aircraft. The larger line drawing across the photo on p. 118 and across the sheet right photo is a cross-sectional cable along the two-side and side tank.





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tailplane was not swept in the engine, after inspecting it decided that the main bungee was enough to provide contact. The clevises were swept as a precautionary safety measure to the lengths and positions required. Transportation of the AC-100 was to be accomplished by the multi role helicopter type remaining shown that the aircraft would fly along the runway, then back track up the runway to a point 21 ft. from the end of the runway with the longer tracks. The engine would be given a spin and the mobility at 2 km. The overrun length until takeoff from this position was 0.817 ft. and total weight was 15,467 lbs. (max. 17,197 lbs.) The maximum takeoff weight of 15,467 lbs. was the regulated takeoff weight. At the time of both takeoff and landing there was a light covering of snow on the upper surfaces of the wings.

The takeoff run at an altitude and base was quite normal as the aircraft would be in a steep climb and would be in a steep climb angle. The aircraft rapidly climbed an extremely steep climbing angle—use writers put the angle achieved in climb from the normal, another 41 to 45 deg.

There was also evidence from witnesses of a slight decrease in rotation as the aircraft nose during this climb. The aircraft stalled with the left wing down at a height of about 150 ft., then ran into the ground in a relatively flat attitude.

After the accident a canine inspection was made. The aircraft had 0.1 cm. of snow on a white snow bank of snow approximately 20-25 cm. deep. There were no skid marks on the runway or on the side banks and nothing showed any tire or track marks.

Final witness. The evidence obtained after the accident showed that:

• Before starting engines at takeoff, the

No. 8 (port) tank contained 590 gal and the No. 3 (starboard) tank contained 185 gal. • None of the booster pumps for either of the No. 4 tanks was switched on. • Checks made by the dc Headline Ammunition Co. indicated that these components and/or a leading angle wall or section of the aircraft, the pressure in the No. 3 tank could have been maintained and the fuel lines in Nos. 1 and 4 tanks could consequently have been pressurized, causing a pressure rise in these tanks.

The switching on of two booster pumps or such No. 4 tank has to be done immediately before takeoff.

The drill cards were not adequate to ensure that this was done.

### Analysis

Analysis. The position of the impact point in relation to the cockpit point, the fact that the aircraft did not begin to ascend an obviously nose-up attitude until a second or two after impact, and the fact that the aircraft did not roll over until impact give a strong indication that impact during initial impact immediately after impact. From witness, the aircraft assumed an extremely steep angle which reached about 45 deg., that is about twice the normal climb angle of 22 deg.

The evidence from the aircraft and the actions of crew and the actions of the crew during the brief flight cannot be established. The only fact is the aircraft and its equipment that could account for the obviously steep climb was the addition of the pitch pulse in the aircraft's digital autopilot to develop the necessary roll to the impact point. In this position for attitude maintenance immediately after impact and using the pitch pulse only about half way to the normal steering position on the pitch scale, applied over 40 seconds. Although this would have at most disrupted the climb, this would have been no indication of a



## ASW EFFECTIVENESS

A new detection system, now under development at Hughes, is designed to increase the U.S. Navy's airborne ASW effectiveness through data processing, control computation, sensor interconnection and sensor navigation.

Urgent and immediate requirements exist for this program for Senior Engineers and Physicists with applicable backgrounds to assist ASW Laboratory Project Managers at the Systems level.

BS or advanced degree from an accredited university and U.S. Citizenship are required. Interest, training and experience should include: (1) an extensive background in analysis and evaluation of airborne ASW weapon systems, including (2) several years of technical experience in the analysis and generation of digital computer programs and software.

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## First C-141 Transport Fuselage Section Completed

Forward fuselage section of the USAF/Lockheed C-141 Starlifter transport aircraft is shown in the production plant at Marietta, Ga. Section was in production five months. It is 30 ft. 1 in. long. Total aircraft length will be 149 ft. First prototype is scheduled to fly later this year.



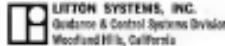


Noel Mervinworth-Loranger, the famous Oxford rower, was drowning yesterday when his favorite racing cap fell into the water. He absorbed who he is one of Hemingway's poems that it was ten minutes before he discovered his cap missing. He turned around and recovered the cap one mile downstream from where he initially lost it. Assuming constant speed, and no allowances for turns around, how fast was the river flowing? —C. C. C. C.

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## WHO'S WHERE

(Continued from page 25)

### Honors and Elections

Dr Charles F. Coddington of Litton Systems Division, Guidance and Control Systems Division of Litton Division-Voigt, has been appointed to the Department of Defense's newly established Advisory Panel on Medical and Biological Sciences.

### Changes

Dr. Robert L. Lerning, manager, Research Division, Allegro Ballistics Laboratory, Falls, W. Va.

William F. Gandy, purchasing manager, Illinois State and Federal Divisions of United Aircraft Corp., Waukegan, Ill., and Richard F. Sprague, factory manager.

T. R. Evans, manager of service engineering operations for the control and guidance systems of General Electric Co.'s Division of Space and Communications, with headquarters in Denver, Colo.

Peter G. Fielding, research development manager and transportation, Room 400, Alaris Applied Research, Inc., Washington, D. C., and Charles E. Letley, research director, also joined the company.

General Dynamics/Information Systems Division, Calif., has announced the following appointment: J. H. Johnson, director, Management Systems; J. M. Haskay, assistant to the vice president administration; K. H. Quisenberry, manager, Material Cost and Admin. in the same division.

Dr. Thomas B. Weber, manager, Environmental Space Engineering Group of Rockwell International Inc., Palmdale, Calif.

Charles F. West, head of the newly established St. Louis, Mo., office for Convair Aerospace Division, San Diego, Calif.

London E. Pfeiffer, director of manufacturing, Throopulb, a division of Laboratory for Electronics Inc., Waltham, Mass., and James E. McGuire, manager, government contracts marketing.

Lockheed Missiles & Space Co., Palo Alto, Calif., has named the following as senior members of the Mechanical and Mathematical Systems Research Laboratory:

Dr. Robert J. Dickson, Dr. William E. Johnson, Dr. James H. Kleppa and Mrs. Mary E. Ladd.

Wilhelm P. Beckhoff, associate director of Electronic Laboratories for Sylvania Electronic Devices, a division of Sylvania Electronic Products, Inc., Belfair, N. Y.

William G. McLaughlin, manager of ad space products, Mechanical Laboratories, a subsidiary of Lockheed Missiles & Space Co., Inc.

Col. James B. Rouse, chief, Communications Mobile Project Field Office, Defense Communications Agency, Fort Monmouth, N. J.

Vigil S. Thorne, senior scientist, Raytheon Research Center, Lexington, Calif.

Dr. F. B. Bunting, manager of the newly formed Research and Development Division of Texas Electronics Division of Long-Term Voigt, Inc., Garfield, Tenn.

Richard H. Pyle, director of robotics engi-



**Said Michael Faraday:** "The amounts of different substances deposited or dissolved by the same quantity of electricity, are proportional to their chemical equivalent weights."

Increasing requirements for parts, very thin films—especially those of ferro-magnetic alloys and alloys—have become critical. To break this bottleneck, one protection method under investigation is a chemical process from an aqueous solution—using metallic salts and a reducing agent.

Scientists at Lockheed Missiles & Space Company have conducted some highly successful experiments, in which extremely pure and thin ferro-magnetic film was deposited on such material as glass and plastics.

Thin film deposition is but one of many phenomena now being investigated at Lockheed Missiles & Space Company in Sunnyvale and Palo Alto, California, on the beautiful San Francisco Peninsula. Engineers and scientists of outstanding talent and ability naturally gravitate to Lockheed. For here they can pursue their special fields of interest in an ideal environment.

A leader in the aerospace field, Lockheed is Systems Manager for such programs as the SHOOTING STAR, IRIDIUM, and other satellites, and the POLARIS PGM. Why not investigate future possibilities at Lockheed? Write Research and Development Staff, Dept. M-205, 999 Melville Avenue, Sunnyvale, California. An Equal Opportunity Employer.

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#### HYDROGEN GAS EXPANSION

#### HEAT TRANSFER ANALYSIS of SUPERSONIC HYPERSONIC VEHICLES

#### PRELIMINARY DESIGN STUDIES of Space Vehicles

#### Propulsion, Structures and Subsystems and Overall

#### Cost Performance Studies

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#### in Stress, Vibration, Loads for

#### Evaluation of Reliability in Grounded Design

#### SYSTEM ANALYST

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#### process for analysis for various user needs.

### PRODUCT ENGINEERING

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**STRUCTURES ANALYST**, designs, analyzes and evaluates of aircraft and aerospace type structures for support or project purposes and other aerospace applications. 30/35 yrs. in E&E or Physics; 5-8 yrs. aerospace vehicle design helpful.

**OPERATIONS ANALYST**, systems analysis on operations or certain problems involving aerospace vehicles, availability, model automation and modern engineering. 30/35 yrs. in E&E or Physics; 5-8 yrs. in aerospace vehicle design helpful.

**HYDRODYNAMICS/FLUID MECHANICS ENGINEER**, develops fluid balance and fluid flow equations and systems associated with aeronautics or aerospace at research and development in space and aerospace applications. 30/35 yrs. in E&E or Physics; 5-8 yrs. in Aerospace vehicle design helpful.

**DESIGN ENGINEER**, responsible for system, structure design, analysis and test. 30/35 yrs. in E&E or Physics; 5-8 yrs. in aerospace analysis, including stress and reliability. The aerospace engineer must be able to design aircraft, missiles and space vehicles. 30/35 yrs. in E&E or Physics; 5-8 yrs. in aerospace vehicle design helpful.

**LIFE SUPPORT SYSTEMS ENGINEER**, designs reliable systems, evaluations, block diagrams for advanced aerospace power, drive and control units and interface with overall system. Some experience in reliability analysis and design. 30/35 yrs. in E&E or Physics; 5-8 yrs. in aerospace vehicle design helpful.

**ELECTRICAL/ELECTRONICS ENGINEER**, designs reliable systems, evaluations, block diagrams for advanced aerospace power, drive and control units and interface with overall system. Some experience in reliability analysis and design. 30/35 yrs. in E&E or Physics; 5-8 yrs. in aerospace vehicle design helpful.

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